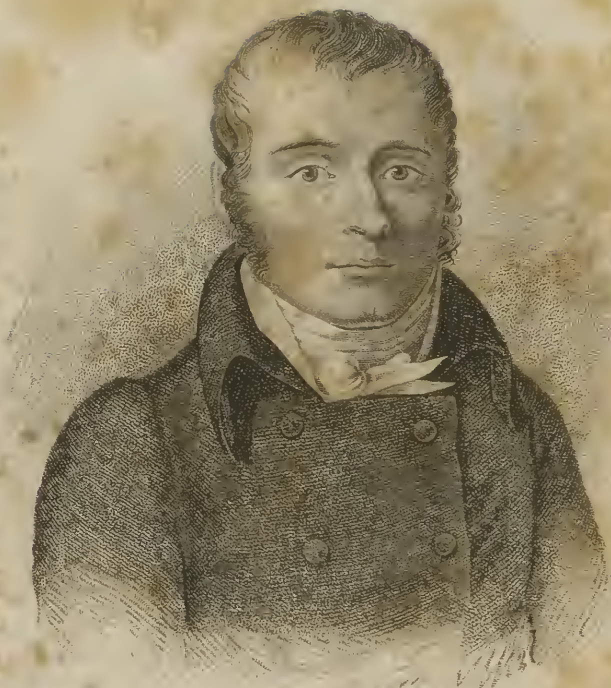

BICHAT

ADDITIONS

TO THE

GENERAL ANATOMY

OF

XAVIER BICHAT.

BY P. A. BECLARD,

PROFESSOR OF ANATOMY AND PHYSIOLOGY TO THE FACULTY OF MEDICINE OF PARIS, &c.

Translated from the French.

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FELLOW OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, AND OF THE MASSACHUSETTS MEDICAL SOCIETY.

BOSTON:

PUBLISHED BY RICHARDSON AND LORD.

J. H. A. FROST, PRINTER.

1823.

DISTRICT OF MASSACHUSETTS, *to wit:*

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BE IT REMEMBERED, That on the eighth day of January, A. D. 1823, in the forty-seventh year of the Independence of the United States of America, *Richardson & Lord*, of the said District, have deposited in this office the title of a book, the right whereof they claim as proprietors, in the words following, *to wit:*

"Additions to the General Anatomy of Xavier Bichat. By P. A. Beclard, Professor of Anatomy and Physiology to the Faculty of Medicine of Paris, &c. Translated from the French. By George Hayward, M. D. Fellow of the American Academy of Arts and Sciences, and of the Massachusetts Medical Society."

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JOHN W. DAVIS,
Clerk of the District of Massachusetts.

NOTICE

BY THE EDITORS OF BICHAT'S GENERAL ANATOMY.*

WE announced in 1818 an edition of Bichat's General Anatomy, to which Messrs. Pinel, Beclard and Laennec, were to contribute, and we engaged to give with it as faithful a portrait as possible of its illustrious author; being editors of the works of Bichat, connected with him for many years in daily relations and constantly honoured with testimonials of his esteem and friendship, we owed this respect to his memory; but unforeseen circumstances have prevented the execution of this design by depriving us of the co-operation of Messrs. Pinel and Laennec.

M. Pinel is compelled to devote to the care of his health the few moments that are left by his private duties; and it is to his son, the worthy inheritor of a name which will form an epoch in the history of medicine, that we are indebted for the notice placed at the commencement of this volume.

* These Additions of Professor Beclard were incorporated into an edition of Bichat's General Anatomy, which was published in Paris in 1821; many copies however were issued in a separate form for the benefit of those who previously owned the works of Bichat.—Tr.

M. Laennec, after a severe disease, has been compelled to leave the capital, at a moment when he would have desired to have demonstrated all that can be drawn from the new mode of investigation which he has made known.

It is then to Professor Beclard alone that we are indebted for this volume of Additions which recent works rendered necessary and which will make complete the General Anatomy.

M. Beclard has laid under contribution not only the writings of the French anatomists and physiologists, but also all the important works published in Germany and England, the Treatises of General Anatomy of J. F. Meckel, J. Gordon, the Prodromus of the great Anatomy of Mascagni, the Hystology (description of the textures) of Meyer, the Table of General Anatomy of Bock, and every thing which has appeared upon each texture in particular. He has thought proper to add to the history of each system an article upon its morbid states, and to devote a particular chapter to the preternatural textures. Most of the facts relative to morbid anatomy have been derived from the general treatises of Morgagni, Voigtel, Baillie, Otto, Cruveilhier, and a great number of particular treatises, among others the excellent work of M. Laennec, who has cultivated this science with so much success.

M. Beclard has added, to the interesting observations which his researches have furnished him, many which are peculiar to him, upon the anatomy of man in health and upon the various alterations of the textures.

M. Bouvier, who is ranked, from having gained eight prizes from the Faculty, among the number of its most

distinguished pupils, has assisted Professor Beclard in his labour, who is pleased to render justice to his zeal and his information.

All the portraits of Bichat, both engravings on copper and lithographic drawings, are far from being resemblances. The medals of the Medical Society of Emulation and the busts even hardly recall any of his features. We find them rather in the picture of his last moments, exhibited at the Saloon in 1818. M. Petroz, who possesses it, has allowed us to consult it, and has entrusted to us the mask in plaster moulded upon the face of Bichat some hours after his death. It is by the aid of this piece, and the advice of all those who, like ourselves, have known him very particularly, that we have succeeded beyond our hopes, since the portrait that we have had engraved for this edition, when viewed by those whom Bichat honoured with his friendship, has recalled immediately to their minds the great man whose remembrance is so dear to them.

HISTORICAL NOTICE

OF

XAVIER BICHAT.

IT is easy to enumerate men, who, in the sciences, have thought for themselves; their genius opens the path of discovery and the multitude follows them. Bichat enjoyed this happy privilege. Anatomy and physiology will always consider him among the number of those whose works are the most fruitful in useful results, and history will assign him one of the first places in that brilliant epoch of medicine which gave so great an eclat to the end of the eighteenth century.

XAVIER BICHAT, born at Thoirette, in the department of Ain, on the 11th of November, 1771, pursued his classical studies at Lyons, and distinguished himself especially in rhetoric and philosophy. He commenced in that city the study of anatomy and surgery under Marc-Antoine Petit. The political troubles of 1793 having soon obliged him to remove from that unfortunate city, he came to Paris with the intention of perfecting himself

at the school of Desault, that he might afterwards practise surgery in the armies. But soon a more brilliant and extended path opened before him. Having one day written down a clinical lecture of Desault, in the absence of the person whose duty it was, the reading of it occasioned the greatest sensation. The master knew henceforth how to appreciate the merit of the pupil. He offered to him his house, treated him as a son and associated him with his glory and his labours.

Endowed with an indefatigable ardour, Bichat did not disappoint the exalted hopes of his benefactor. The variety of his occupations was his only relaxation, and his methodical mind and wonderful facility made him acquire with ease all the knowledge which is ordinarily the fruit of long and painful study.

Bichat was scarcely twenty three years of age when Desault died, (in 1795) and so far from being overwhelmed by this unforeseen loss, it appeared to redouble his activity. The dressings at the Hôtel-Dieu, the daily visits to the patients, consultations, dissections, and operations on the dead body, had heretofore employed all his time; the death of Desault created for him new occupations; gratitude made it his duty to publish the researches and labours of the master who had adopted him. He wished also then to commence his career as a teacher.

In the winter of 1797 he gave his first course of anatomy, and his second the year following. After his duty at the Hôtel-Dieu was finished, he superintended the dissections of more than eighty pupils; he performed numerous physiological experiments upon living animals;

prepared for the press the surgical works of Desault, and composed memoirs for the Medical Society of Emulation, of which he was one of the founders.

It was at this period that a revolution took place which was to change the face of the science. Professor Pinel was the first to perceive that a disease can only be an alteration of textures or of organs; that it is necessary to study these organs and textures, first under the relation of their structure and then under that of their functions, before we can arrive with certainty at a knowledge of their alterations; and that thus analysis in medicine consists in referring the symptoms, the external signs of diseases, to the suffering and morbid alteration of some organs; to study them in their seat, is to derive from the knowledge of this seat the indications of the treatment, and finally to class them according to the analogy or the difference of the affected textures. Such was the original idea, which presiding over the execution of the *Nosographie Philosophique*, published in 1798, had just overthrown forever that badly constructed scaffolding raised upon the incoherent plans of the chemical, humoral and mathematical physicians, and which would lay the first foundations of a true physical science.

Bichat, struck with the description and the distinction of the mucous and serous membranes, and especially with the classification of their diseases, seized this first idea, made new researches, and extended them to all the membranes of the body; and in eighteen months after (in 1800) he published his Treatise upon the Membranes, a model of precision, originality and analytical method, which was

afterwards embraced in his General Anatomy, enriched with happy developments and new ornaments.

It was a spectacle worthy the regard of history, that noble emulation, frank and generous rivalship, in this period of enthusiasm and discovery, should turn every thing to the advantage of science. If Bichat owed to Professor Pinel the idea of his work, the latter in his turn drew new lights from the researches of the young anatomist, and corrected in the second edition of his Nosography the classification of the diseases of the fibrous, synovial and cellular systems. This alliance of nosography with anatomy and physiology, this mutual exchange of instruction, formed one of the characteristic traits of this period.

Physiology is the inseparable companion of anatomy; the structure of the organs is only interesting as it leads to researches with regard to their functions; thus the Treatise upon Life and Death followed soon after the first works of Bichat upon Anatomy; it appeared the same year. It is in this work that he began to develop that distinction of the two lives, the organic and animal, which he has reproduced under a thousand forms, but which cannot be admitted, as has been proved by Legallois, without some limitations. The richness of the means with which he pursued the development of this idea cannot be too much admired. The beautiful experiments that fill his Treatise, the facts that are made known by them and the bold and profound thoughts that shine in a great number of passages, are more than sufficient to make us excuse some flights of a vivid and ardent imagination.

Bichat, in his two first works, had only thought of anatomy and physiology; but the circle of his ideas enlarging as he reflected on his subject, he ventured to leave the beaten track, and published in the following year his General Anatomy, which placed the seal upon his reputation, and which was translated into almost every language. Before his time, anatomy had been confined to the simple description of the organs; he was the first who thought himself able to rise to bolder views. He observed that the human body exhibits uniform, identical systems, subjected to the same laws of growth, nutrition and diseases; that these systems, everywhere present, can be studied in their structure as in their functions, so as to embrace the most general results of their organization, and the most fruitful and useful applications. From that period he created a new science, *General Anatomy*. He created for anatomy and physiology, a species of philosophy, to which there was nothing wanting to render it perfect, but that it should not be limited to the study of the textures of man. He should have extended his views to all classes of animals, traced in them the inferiority of the textures and organs, and observed the properties which they bore or the new functions to which they are called. Comparative anatomy and physiology would have furnished to his lively and brilliant imagination the most novel views, the most substantial knowledge, and the most ingenious analogies.

It is astonishing that Bichat with that independence of opinion which characterized him, should have so often brought forward, in his General Anatomy, those old ideas,

which for two thousand years have continued in the schools, those words *vital force* and *vital properties,* abstractions which he seems to have taken for realities, to which he gave a separate existence, and which he made perform so important a part in the animal economy. Yet for a long time past we have only recognized and we ought to recognize but two things in organization, structure and functions of organ. The philosopher should confine himself to the study and observation of the sensible phenomena which matter exhibits in these two states, without endeavouring to penetrate further; beyond, an immense abyss commences; we should take care lest we fall into it.

The General Anatomy contains also the first germs of a science to which Bichat would no doubt have devoted his whole life, I refer to morbid anatomy. It was a natural consequence of his first labours; after having studied the structure and functions of the organs, and performed upon living animals experiments for the exact observation of their phenomena, either in a state of health or in that of disease, he was naturally led to seek for a knowledge of the changes in their texture which this last state brings.

Appointed, at the age of twenty-nine, physician to the Hôtel Dieu, he devoted himself to this kind of research with all the activity that was natural to him; in one single winter he opened more than six hundred bodies, and soon after he stated in a course of lectures his observations upon the morbid state of the organs. It was in this course that he demonstrated that each texture has a peculiar mode of disease as it has a peculiar character of vitality; that even

in the intestines, the morbid state of a membrane can connect itself with the sound state of the neighbouring membranes, and that it is very important to know how to distinguish, by a correct analysis, the peculiar suffering of these different textures. BICHAT began to unite into a body of doctrine the fragments of morbid anatomy scattered throughout his works; he would have raised to the science a monument worthy of it and of the great epoch which owed to his labours a part of its distinction. But he died during the printing of his *Treatise on Descriptive Anatomy,* the two first volumes of which he published himself, (in 1801 and 1802) and left the third imperfect.

One day, after having visited some specimens of morbid anatomy subjected to maceration and having been exposed without any precaution to their noxious exhalations, he fell in descending a staircase of the Hôtel-Dieu, and the slight shock occasioned by this fall deprived him of his senses. A violent affection of the head, very severe gastric symptoms, a continual tendency to stupor and ataxic phenomena succeeded with rapidity, and BICHAT sunk on the fourteenth day of his disease, 22d of July, 1802.

Thus were turned to bitter regrets the hopes that he was just realizing; thus was arrested in his rapid flight this genius who seemed to hover over the whole edifice of medical science. BICHAT, embracing in a single view all the knowledge connected with medicine, saw on the one hand anatomy brought to the greatest degree of exactness, physiology established for the first time upon facts, and the description of diseases reduced to simple and clear

language; and on the other, morbid anatomy still separated from physiology, and therapeutics still abandoned to empiricism. He had conceived the project of connecting by a regular chain all the parts of the art of healing, of raising a complete system of medicine founded upon anatomy, upon the study of the functions in the state of health and in that of disease, upon the distinction of the textures, the sympathy which connects them together, the observation of the local and the general effects of medicines, and the results of the examination of dead bodies. He would no doubt have executed this plan, vast and methodical as it is, which, notwithstanding the pretensions of some physicians of our time, is yet but a project.

Such is in fact the happy influence which the great men who appear from time to time have upon their age, that from their labours as from an inexhaustible source, new sciences seem to flow. Those who have nothing to say continually repeat what has been said; but before the man of genius the field of discovery seems to enlarge from day to day. How many researches has he to make in morbid anatomy, a physical science, which only considers the symptoms of diseases as the signs which should be referred to the alteration of the textures, who seeks in these textures the various lesions produced by the different degrees of diseases, and who only endeavours to go from the alterations to the symptoms! How little advanced is morbid physiology, the knowledge of the functions of the organs by the different modifications which the alterations produce in these functions, which will alone resolve an infinity of enigmatical problems of our organization, and

especially make known by pathological analysis the different properties of the nervous system! How much has anatomical chemistry been neglected even to this day, the research into the composition of the textures, which would alone be able to establish the identity or the difference of the systems and the apparatus of the human body! Pathological chemistry, the investigation of the chemical changes produced by the alterations in the organs, is it not an entirely new science, upon which we have hardly thought, and which will perhaps give the explanation of many phenomena, whose character and cause we are unable to determine by other means?

How many researches has Bichat opened for us the way! What an immense inheritance has he left us to improve! The mind can hardly conceive that the life of one man was sufficient for so many labours, for so many discoveries, either made or pointed out; Bichat died before he completed his thirty-second year!

SCIPIO PINEL.

GENERAL ANATAOMY.

ADDITIONS

TO THE

GENERAL OBSERVATIONS.

Anatomical Elements.

Page 49, *volume* 1, *Bichat's General Anatomy.*— "If you would have only general notions of anatomy, you can study each organ as a whole; but it is essential to separate the textures, if you have a desire to analyze with accuracy its intimate structure."

Some have attempted to extend too far this analysis of the textures; and, as in chemistry, we recognise in the organic substances the immediate principles which themselves result from the union of the simple elementary bodies, such as oxygen, hydrogen, carbon and azote, they have sought to discover what are, in the organization of animals, these primitive elements, the assemblage of which, variously modified, gives rise to the secondary textures, to the organic systems of Bichat.

3

The ancients had already admitted an elementary fibre, (*fibra simplicissima*) composed of earthy particles united by a species of gluten, and being able to assume two forms, the one linear and the other lamellated. This fibre was the base of the cellular texture, which they regarded as the substratum of all the solids of the human body. But this elementary fibre has never been seen, and moreover, there are textures which we cannot reduce by decomposition to the simple cellular substratum.

An opinion more conformable to nature is that which recognizes in the organization three distinct elements, the cellular, nervous and muscular fibre. Very striking differences characterize these three primitive textures, and do not permit them to be confounded. 1st. In relation to the form; the cellular fibre is composed of fine laminæ and delicate filaments, white and extensible; the nervous, of a soft substance nearly fluid, contained in a cellular envelope; the muscular, of round filaments, soft, pulpy, greyish or red. 2d. In relation to the chemical nature; one is resolved into almost pure gelatine when it is treated with boiling water; the other is essentially formed by albumen united to a fat substance, and the third by fibrin. 3d. In relation to the vital properties; those of the cellular fibre are obscure and are confined to the latent sensibility and the invisible contraction known under the name of *insensible organic contractility*, whilst the nervous has, besides the faculty of transmitting the impressions to the mind, *sensibility* properly so called; the muscular on the contrary, is distinguished by the *irritability* which it possesses.

All the organized textures have for their base one of these three primitive fibres, or result from the union of many of them; thus the cellular element is found in most of the organic systems; it constitutes almost alone the

cellular texture, the serous membranes, the dermis of the skin and of the mucous membranes, the parietes of the sanguiferous and lymphatic vessels, and the fibrous organs ; thus the muscular system is formed by the assemblage of the muscular and cellular elements, &c.

This division of the primitive textures, pointed out by Haller and Blumenbach, has been followed by most modern anatomists. Some have modified it by adding to them a fourth element, the fibrous texture. It is to this new fibre that M. Chaussier has given the name of *albugineous fibre.* The characters which he gives to it are a white colour, shining like satin, and a considerable density ; boiling water converts it in great part to gelatine ; it is but slightly extensible and very resisting ; its vital properties are hardly perceptible ; it is this which forms the fibrous or albugineous membranes, the tendons, aponeuroses and ligaments. These characters resemble very much those of the cellular fibre, from which the albuginea seems to differ only in the greater approximation of the particles, which is the reason of the greater tenacity it possesses. We can even refer to a modification of the cellular fibre the elastic, yellowish texture, which constitutes the middle texture of the arteries, the yellow ligaments of the vertebræ, the posterior cervical ligament of animals, &c. and which is distinguished by its colour and its elasticity from the common or albugineous fibrous texture of M. Chaussier. Nothing proves more the great affinity which naturally approximates the cellular fibre and these two species of fibrous textures, than the facility with which they are transformed into cellular texture, when they disappear preternaturally.

If we consider the organized elements under another point of view, we see that it is possible to bring by the analytical method the different textures of the animal

economy to a certain number of primitive forms, which are inseparable elements of all organization. This observation has occasioned many classifications of forms or elementary textures. The first and most simple is that which admits but two of them; 1st, *the fibrous form*; 2d, *the lamellated form*, a division already established by the ancients. A greater extent in length characterizes *the fibre*; the *lamina* has dimensions nearly equal in length and breadth, but little thickness. The fibres and the laminæ can by their interlacing leave between them spaces variously formed, called *cells*. The fibrous structure predominates; it is evident in the nerves, the muscles, the bones, and the fibrous textures; some organs exhibit at the same time a fibrous and lamellated texture.

Others recognise a greater number of elementary forms and add to the two preceding ones the *globular* and the *granulated* form; the first belongs especially to the fluids; the second is observed in the glandular texture. They admit besides as secondary forms, 1st, the cellular; 2d, the vascular; 3d, the solid, as that of the cartilages, the bones, &c.

Other divisions also exist which appear to be founded at the same time upon the forms and upon the nature of the textures. It is thus that Walter establishes, 1st, a cellular or membranous texture; 2d, a vascular or fibrous one; 3d, a nervous one. So we find in the classification of Dumas, 1st, the cellular or spongy texture; 2d, the muscular or fibrous texture; 3d, the mixed or parenchymatous texture; 4th, the lamellated or osseous texture. These divisions are by no means preferable; they are insufficient if they represent the secondary textures or organic systems, and too multiplied if they only express the primitive elementary forms.

Notwithstanding the delicacy of microscopic researches and the deceptions so difficult to be avoided in this kind of experiments, the labours of Hewson, Prochaska, Wenzel and other observers, have served for the basis of a theory of the organized elements which differs considerably from the other opinions upon this subject, and which has been particularly developed latterly by J. F. Meckel.

According to this anatomist, the solids and the fluids of the human body can be reduced, in the last analysis, to two elementary substances, one formed by globules, the other by a coagulable matter, which, either alone or united to the first, constitutes the living solids, if it be in a liquid state, and gives origin to the solid textures, if it be in a concrete state.

The globules exhibit, in their appearance and even in their nature, differences which are especially relative to the places in which they are examined. In the blood, they appear flat and composed of a central part which is solid, and of an external part which is hollow and vesicular. Those of the kidneys are smaller than those of the spleen; the globules of the liver are still more delicate. The globules contained in the substance of the nerves exhibit a less size than those of the blood; it is the same in the lymph, the milk and the chyle. Certain fluids, as the urine, do not contain globules. Many solids are entirely destitute of them; such are the cellular texture, the fibrous parts, the cartilages and the bones. They abound on the contrary in the blood, the nerves and the muscles. They form the essential part of the textures, the colour and nature of which they determine.

These globules appear to undergo modifications according to age; but direct experiments are wanting on this point. Hewson says he has found in birds and reptiles, the globules of the blood of a different form and size in

the embryo and the adult animal. In the first periods after conception, the mucous and homogeneous mass which constitutes the embryo does not contain globules; it is not till a more advanced period that it is composed of two substances, one fluid and the other solid, every where immersed in the first. The globules are then very apparent, more distinct than they will be afterwards; they are seen in all parts of the embryo.

These two elements, the globules and the coagulable fluid, may assume the form of fibres or laminæ. The lamellated form belongs almost exclusively to the fluid matter. The fibres may be formed by this substance only, as we see in the bones, the tendons, &c.; they are the effect most often of the union of the globules and the concrete fluid, of which the nervous and muscular systems exhibit examples.

These considerations of Meckel upon the organization of animals have some relation with the division of the organized elements established by Pfaff, which admits as primitive elements fibres and cells, themselves formed of a series of particles or globules. They differ from it in this that we find in it, besides the solid globules, the idea of a concrete fluid substance, analogous to that which the ancients designated by the name of gluten. It is according to Meckel the cellular texture which represents this substance; it regards in fact this texture as a sort of concrete fluid, as we shall see in the article on the cellular system.

Classification of Morbid Anatomy.

Page 59.—" This course (of classing the alterations according to the systems to which they belong) is incontestably the most natural, though, as in all divisions in

which we wish to subject nature to our views, there are many cases which it almost excludes."

The recent progress of morbid anatomy has occasioned new classifications which, without being entirely exempt from the inconvenience of constrained approximations, nevertheless contain useful divisions founded upon natural relations established between the various organic alterations. Bayle, Laennec, Cruveilhier, J. F. Meckel, &c. have been particularly engaged in this subject.

1st. Having seen that the alterations of texture have nearly the same characters, whatever may be the texture they affect, they have found the greatest advantage in uniting them into one and the same class, so that they avoid the numberless repetitions which an opposite method produces; they exhibit at the same time and under the same point of view, analogous objects, and nothing is more proper, as we know, to hasten the progress of any science.

2d. The same method has been applied, though with less success, to the derangements that affect only the external forms. It is scarcely any where but in the original defects of conformation that a methodical order can be followed or that it is attended with any real utility. The preternatural derangements of form have too little resemblance, to make it advantageous to approximate them. Thus it has been proposed to preserve here the anatomical order adopted by Bonet, Morgagni and in part by Bichat, till the science shall be sufficiently advanced to substitute another for it.

They have followed the same principles, as much as possible in the subdivisions. The most natural and numerous is that of the transformations or organic productions, which the class of the alterations of texture em-

braces. They are characterized by the preternatural development of a new texture in the part which is the seat of them. They are divided, according as this texture has some analogy in the economy or is wholly foreign to it, into organic transformations properly so called, and into degenerations or preternatural textures which only exist in a state of disease.

J. F. Meckel is hitherto the only one who has made an application of these data to a complete system of morbid anatomy. The following is the order which he has pursued in a very extensive treatise that he has published in Germany on this subject :

He admits the two great divisions of which we have spoken, viz. the alterations of form and those of texture. Among the first are found arranged, 1st, the original defects of conformation, subdivided according as they affect the number or nature of the parts, into defects of *quantity* and defects of *quality* ; 2d, acquired derangements of size, situation, configuration, &c. which comprehends luxations, hernias, solutions of continuity, contractions, dilatations, atrophies, &c.

The alterations of texture are confined to two principal heads. Some change only the physical properties of the affected texture, such as the colour and density. The others completely change its organization. These being often the product of inflammation, this affection is naturally placed here. The manner of the separation of the injured organs is described at the same time. Finally come the transformations and degenerations properly so called. The author still ranks among the preternatural productions worms and concretions.

We shall adopt the following order in the exposition of the morbid alterations of each system.

- 1st. Alterations in the external forms
  - Situation.
  - Size.
    - Hypertrophy.
    - Atrophy.
  - Density.
  - Configuration.
- 2d. Alterations in the organization by
  - Inflammation.
  - Mechanical Lesion
    - Wounds.
    - Foreign Bodies.
  - Transformation.
  - Degeneration.
- 3d. Alterations in the development
  - Defects of conformation.
  - Preternatural Development.

ADDITIONS

TO THE

CELLULAR SYSTEM.

Adipose Texture.

Page 128.—"We shall see also, that the fat is separated by an exhalation analogous to that of all the other exhaled fluids, that is to say, by vessels of a particular order, which are intermediate between the extremities of the arteries and the cellular texture. We can apply to the exhalants of fat, what will be said upon the exhalant system in general."

The fat does not appear to be simply deposited in the small spaces of the cellular texture; it has a texture which is peculiar to it and which contains the oily fluid of which it is formed. The existence of the adipose texture, which was imperfectly known to Malpighi, distinctly pointed out by A. de Bergen and Morgagni, has been particularly demonstrated by W. Hunter. It has been described in turns under the names of *cellular texture*, by calling our cellular texture *filamentous*, of *fatty texture* or *pannicle*, of *adipose membrane or network*, of *adipose tunics* or *vesicles*, &c.

The general arrangement of the adipose texture already exhibits many peculiarities which cannot arise from the fat; this fluid cannot of itself have a determinate form, and nothing is more variable than the external conformation of the fatty texture. In one place it is a membranous layer more or less thick, analogous to that which exists under the skin, in which it constitutes the fatty pannicle. In another it is in irregular masses, such as are found around the kidneys, in the orbits and the thick part of the cheeks. In other places the adipose texture exhibits the appearance of pyriform elongations, pediculated, such as are seen in the appendices of the omentum, around the arteries which go to the peritoneum, in the openings of the umbilicus and the infra-pubien rings, &c.; in the omentum it forms flattened ribbons or kinds of network which follow the course of the blood-vessels. Accumulated in some parts, it appears under the form of tumours more or less large and prominent, examples of which are seen in the eminences upon the nates of Hottentot women, in those on the backs of dromedaries, camels, the bos urus, and the tail of the Barbary sheep.

The adipose texture, considered in its external organization, is not less distinct from the fat which it contains. Whatever may be the different forms it assumes, its structure is every where the same. It is divided into rounded bunches, separated from each other by grooves more or less deep, of a form irregularly oval, and of a diameter varying from a line to half an inch; their size differs also according to the degree of corpulency and according to the part examined. Each of them is composed of smaller particles, which are easily separated by dissection. These are spheroidal, miliary, compressed, similar in form to the seeds of the grape or still more to the vesicular granulations which constitute the inside of oranges, and other

fruits of the family of hesperides ; we discover, by the aid of the microscope that they are themselves a collection of united vesicles, exhibiting precisely the same appearance, except as to size, since according to Monro, their diameter is from the eight hundredth to the six hundredth of an inch. According to Wolff these vesicles may have a different size in different species of animals. They do not appear to communicate with each other; their parietes are delicate and transparent, which has made Monro and Clopton-Havers who have observed them in the marrow of the bones, compare them to collections of small pearls. They contain the fatty fluid, the yellowish colour of which is visible.

The adipose texture is provided with a vascular apparatus, which has been very well described and drawn by Mascagni. Arterial and venous branches are lodged in the grooves which separate the fatty particles; their divisions represent, by their anastomoses, capillary networks which run along the interstices of the small masses or particles of which they are composed ; each of these particles receives a little artery and a little vein which form for it a sort of vascular pedicle; the microscopic vesicles themselves are penetrated by the most delicate ramifications, which follow at first their interstices, form for them also a kind of pedicle and finally terminate in their parietes. This collectiòn of vessels and agglomerated grains has some resemblance to a bunch of grapes suspended by its peduncle, and in which each of the grains that compose it, has besides its own pedicle. This arrangement is easily seen upon a portion of fat taken from an injected body, or still better from a part naturally infiltrated with blood.

A very delicate cellular texture seems to exist between the vesicles and around them ; this texture becomes more

apparent in the interstices of the particles visible to the naked eye, which it connects together ; the little bunches that arise from them are united by a firmer texture almost fibrous in some parts, evidently ligamentous in the palms of the hands, on the soles of the feet, &c.

The fatty texture no doubt contains absorbent vessels, but we are ignorant of their arrangement. It is the same with regard to the nerves. Its intimate nature appears to resemble very much that of the cellular texture. It is in fact a soft substance, whitish, extensible, contracting when distension is removed, appearing under the form of fine and semi-transparent laminæ and having the greatest analogy with the lamellated or cellular fibre. If the fat, which it contains, disappears preternaturally, the vesicles flatten and are confounded with the surrounding cellular texture, without leaving any trace of their existence. Hunter says, nevertheless, that in these cases the cellular texture differs in some of its properties from that which never contained adipose vesicles, and he attributes these differences to the presence of the empty vesicles which the first contains.

It would be wrong to conclude from the resemblance that is found between the fatty and cellular textures that they are precisely the same. It is easy to point out the characters which distinguish them. 1st. The adipose vesicles are shut on all sides, and their substance is not permeable to the fluids which tend to penetrate it, very different in this from the areolar substance of the lamellated texture. This is proved by many facts. Take a piece of adipose texture, raise its temperature gradually by means of warm water, until it is sufficient to melt the fat without altering the structure of the vesicles, the oily matter will remain contained in them without flowing out. Expose a bunch of fat to the heat of the sun suffi-

cient to raise the centigrade thermometer to + 40 degrees, you are very certain that at such a temperature the fat must be perfectly fluid; yet not an atom of it will flow out; cut some of the vesicles, and the oily fluid will immediately appear. We obtain also the same result by compressing between the fingers a fatty mass; the fat does not escape unless the vesicles are ruptured. In the most extensive emphysemas, in the greatest serous infiltrations, the effused fluids never penetrate the vesicles; the fat remains distinct and is not mixed with these fluids. If it were otherwise, should we not see during life, the fat, fluid at the ordinary temperature of the body, constantly descending to the lowest places, as takes place with the serum of dropsical patients, yielding to external pressure in parts which, such as the feet and the nates, are continually subjected to it, as is observed also in œdema? The adipose vesicles do not form, like the cellular texture, one continued whole; they are merely contiguous to each other. This is easily demonstrated by inspection. It is also seen in anasarca; the liquid, which is poured in the cellular texture that is interposed between the adipose particles, separates them, and they continue insulated in the serum that surrounds them. 3d. There is another character. Wherever cellular texture is found, there are parts always destitute of the fatty texture, even in the fattest subjects. Does not this fact seem to indicate, that there must be a peculiar organization in the cellular texture, that fat may be developed in it? 4th. Finally their uses are very different; those of the adipose texture only relate to the fat that is constantly exhaled in the interior of its vesicles, and constantly taken up by the absorbent vessels; the cellular texture has much more important uses, since it forms a common link which unites all the parts at the same time that it

insulates them, and serves to facilitate their motions and to maintain the harmony of their functions.

Chemical Nature of the Fat.

Page 128.—" I will not treat of the chemical nature of fat. This would lead me into details foreign to this work. Besides, I could add nothing to what modern chemists have said upon this subject."

The recent labours of M. Chevreul upon the fixed oils and the different species of fat, have given results too satisfactory not to be mentioned here. The fat, far from being an immediate principle of animals, as has for a long time been thought, is composed of two peculiar principles, non-acid, designated from their consistence, by the names of *stéarine* and *élaïne.*

Stéarine exhibits a solid mass, without colour, almost inodorous, insipid, soluble in alkohol and preserving the solid state at the temperature of 38 degrees of the centigrade thermometer. Elaïne on the contrary, is fluid at a temperature of 17 or 18 degrees ; it is without colour or yellowish, lighter than water and much more soluble in alkohol than stéarine. It is by taking advantage of this last property, that we can separate these two principles. For this purpose we treat a certain quantity of fat with boiling alkohol ; as the liquor becomes cold the stéarine is precipitated, taking with it a little élaïne ; the greater part of the élaïne remains in solution with a little stéarine. The action of cold upon fat, and the continued contact of this substance with paper that has not been sized, can also serve to demonstrate the existence of its immediate materials. In the first case, the stéarine becomes solid, whilst the élaïne preserves its fluidity ; in the second, the

élaïne is absorbed by the paper and the stéarine remains on the surface.

The proportion of the principles of the fat is not the same in all animals nor in all parts of the same animal, hence all the varieties of consistence which that of man exhibits. However, as stéarine is not more solid, even when pure, at a degree of heat equal to the temperature of the body, the fat ought at least to be semi-fluid during life, and this is in fact what is observed in surgical operations, during which there often flows with the blood some oily drops coming from the cutaneous adipose vesicles.

Besides the peculiar acid, (the sebacic acid) which is produced during the distillation of fat, there are two others that are obtained by treating it properly with an alkali or some metallic oxyd; one is the *margaric* acid, so called from its pearl colour, the other the *oleic* acid. Soaps, which result from the action of alkalies upon oils are nothing but salts formed by these two acids and the base that is employed. M. Chevreul thinks that something analogous takes place in the spontaneous decomposition of muscular flesh, when it happens without the contact of the air; he considers the fat of dead bodies which is produced in this way as a kind of soap, which is the result of the action of the ammonia coming from the decomposition upon the fat contained in the muscle.

Intimate nature of the Cellular Texture.

Page 131.—" All these vague ideas of concrete juices, of inorganic glue, of hardened juice, that have been applied to the cellular texture, have no solid foundation, and rest neither upon experiment nor observation, and ought to be banished from a science in which imagination is nothing and facts every thing."

The ancients do not appear to have been acquainted with the cellular texture, at least they do not mention it in their writings. It is without cause that some have pretended, that they have found some notions of it in a passage of Hippocrates, in which the question is respecting the general permeability of the textures. Adrien Spigel is one of the first who have spoken of it. Vesalius and others made it known successively in different parts of the body. It is only since Haller and Bergen that it has been considered as generally distributed to all the parts. Bordeu appears to be the first who compared the cellular texture to a sort of slaver or glue. Quesnay said that it rather resembled a fluid matter than an organized solid. Wolff went further; rejecting all idea of cells, he regarded the cellular texture as a homogeneous substance, glutinous and without evident organization. Blumenbach, Ern. Platner and J. F. Meckel, have adopted this opinion. This last has made the cellular texture his concrete fluid element. The following are the observations and facts upon which these anatomists rely.

1st. Inspection, say they, does not discover in the cellular system the fibres or layers of which it is supposed to be formed. Examine it under the skin, between the muscles, around the arteries, on the exterior of the membranes, every where is found a substance semi-fluid, transparent, tenacious and without any appearance of fibrous or lamellated structure. If fibres or laminæ be developed, it is owing solely to the means of investigation that are employed. Thus when we separate from each other two contiguous organs, which are united by cellular texture, two muscles, two fasciculi of the same muscle or two muscular fibres; when we raise this texture from the surface of the organs it covers, it yields to the distension, is elongated and presents the appearance of delicate laminæ,

which are changed to round filaments if the distension be carried further, precisely as if it were a piece of glue or paste, according to the expression of Bordeu. The distension having ceased, the parts approximate, and the interposed cellular layer reappears homogeneous and perfectly continuous. So when we examine the cellular texture of the scrotum by stretching it to a kind of membrane, it is evident that the laminæ and the interlaced filaments that are seen are the product of distension, and this apparent organization is not observed until after having developed it artificially.

2d. These pretended cells do not exist either in the mucous texture, which does not exhibit openings on its surface, as it would if there were these little cavities. When cavities are found there, it is because foreign bodies raise it up and give it a vesicular appearance. When, for example, the cellular texture is drawn in different directions, it often happens that it is penetrated with air in its interior. This air then assumes the form of bladders, as it does in soap suds. But if we press upon these bladders, they disappear; and, if we afterwards reproduce them, they may be very different from the first. We give them very various forms, increase or diminish their number, precisely as in soap suds. Inflation produces also in the mucous texture a cellular appearance, which is explained in the same way by its state of softness and semi-fluidity. The injected air penetrates it easily, and the distension, which it occasions, produces that appearance of fibres and interlaced laminæ, which has been said to be peculiar to this texture, whilst it is a form which it possesses but for a moment. It is the same with regard to the cells observed after congelation; they are interstices preternaturally produced by the presence of a fluid diffused in the cellular texture.

3d. Any part of the cellular system exhibits by turns, fibres, laminæ or cells, according to the process employed to develop in it either one or the other structure. Distension produces laminæ or fibres, according to the extent to which it is carried; inflation produces cells, &c.

4th. The cellular texture is permeable; most fluids, such as air, water, pus and urine traverse it easily and run over a great extent in its interior; solid bodies even have penetrated it, and have gone longer or shorter distances. How can we admit that bodies thus immersed in the mucous texture follow precisely the direction of the cells and of their orifices? Is it not rather the medium, and, as it were, viscid consistence of this texture which permits it to yield to the effort of the substances which tend to penetrate it, and accommodate itself at the same time to the various forms which they imprint upon it?

5th. Finally, they add, that in the fœtus of man and in the lowest classes of animals it is impossible, under any circumstance, to discover any organization in the cellular texture; a mucous and homogeneous mass only is found.

It is for anatomical inspection to pronounce upon the validity of these objections, which cannot be overthrown by the single consideration of the phenomena of vitality which the cellular texture exhibits in diseases. Would it be the first example of a texture endowed with life, whose homogeneous structure did not allow distinct laminæ or fibres to be seen? Is it not so with the cerebral substance, the cartilaginous texture and the serous membranes? We do not seek to know if the texture peculiar to the cellular system be the seat of an evident vital action; this point would not be contested, but only if we should admit that it has a fibrous or lamellated organization, or whether this organization is developed, except under certain influences of which it is the immediate result. What is certain is,

that it appears under many circumstances as if it were really spongy or cellular, and there can be no inconvenience in regarding it as such.

MORBID ANATOMY OF THE CELLULAR SYSTEM.

I. *Alterations in the external forms.*

The size of the cellular texture can be increased in consequence of a more copious exhalation of the fluids it contains. This is what happens in anasarca and in obesity or corpulency. The serum accumulated in anasarca resembles that of dropsies. It runs moreover freely through the cellular texture, and collects in general in the most depending parts. The looseness of this texture in some regions disposes it also to infiltration. In old oedemas, the cellular texture sometimes acquires a very great thickness; it seems as if there were made an exudation of a fluid capable of concretion which increases its density by adding to the laminæ which compose it.

Obesity or the accumulation of fat is general or local; the first has been examined under the article upon the cellular fat.

Fatty tumours, which constitute the second, are of very various forms; their size is sometimes very considerable; frequently they are provided with a pedicle through which the vessels enter. A cellular coat invests them on the exterior; their structure is that of the adipose texture. The vesicles appear to be more numerous than in a state of health, for Monro has observed that their diameter is

the same. These tumours are especially developed in parts which contain much fat; hence the frequency of wens or sub-cutaneous fatty tumours.

Besides the fluids naturally contained in the cellular texture, air can also accumulate in it, which constitutes emphysema. This last is more or less extended. It is sometimes developed after death, in apoplexy, urinous effusions, &c.

An increase of size and density at the same time appears to constitute the disease described under the name of hardening of the cellular texture. There is only found in it in fact a greater thickness and consistence of this texture, which scarcely yields to the pressure of the finger; there is usually joined with it a more or less considerable serous infiltration. This affection is, as we know, almost exclusively confined to new born infants. It is below the skin that it most commonly appears; it has also been seen in the inter-muscular cellular texture.

The elephantiasis or disease of Barbadoes is owing to an alteration of the same kind.

II. *Alterations in the organization.*

Inflammation of the cellular texture is very frequent; there are many varieties of it, particularly according to the part it attacks.

In acute inflammation, in phlegmon properly so called, the cellular texture is of a more or less bright red, as if infiltrated with blood; the serum disappears, the small spaces being obstructed are much less permeable than in the natural state; they are afterwards filled with a concrete albuminous matter, which resembles a kind of jelly. The ulterior phenomena differ according to the mode of termination. In the most common cases, suppuration takes

place, the pus hollows out a cavity which is continually enlarging, and an abscess is formed; or there is an absorption of the effused albuminous matter, and consequent resolution. At other times this matter seems to become organized at the same time that its consistence increases; it is insensibly confounded with the organ which furnishes it; this is what is observed in the termination by induration. In gangrene, the mortified cellular texture produces soft eschars, of a whitish or grayish colour; it is reduced to a sort of putridity.

Chronic inflammation especially produces induration, as we see in old ulcers. We frequently find as its consequence that sort of brittleness of which Bichat speaks (page 142). In some cases the inflammation is accompanied with ulceration and destruction of the cellular texture.

The cellular texture, when simply divided by a mechanical lesion, unites quickly, if the divided edges be in contact; this is what takes place in the closing of abscesses, in the union of wounds by the first intention, &c. The adhesion is established by means of a coagulable fluid which is effused, becomes concrete and organized, so as to form a new texture for some time more dense than the surrounding cellular texture, with which it finally becomes confounded.

The cellular texture, laid bare by a solution of continuity with a loss of substance, exhibits all the phenomena described in the formation of fleshy granulations and of cicatrization. Vanhoorn has seen in amputations the fatty cellular texture disappear at first from the surface of the wound, to be afterwards replaced by a new texture, more dense and resisting than the first.

Foreign bodies introduced into the cellular texture produce there a more or less severe inflammation; the suppu-

ration which results from it brings them gradually to the exterior, so that if they be deeply situated, they thus go a considerable distance. We see this texture then approximating, constantly uniting behind the foreign body, whilst it suppurates and opens before it. This peculiar course of the inflammation has given it the name of the *expulsory inflammation.*

In some cases however, foreign bodies remain in the cellular texture without producing any inconvenience there ; there is formed around them a kind of membrane, a cyst, which keeps the neighbouring parts from their contact; this is what takes place in some sanguineous effusions, when the presence of the coagulum does not occasion the formation of an abscess. The sac, which contains the blood in false aneurisms, is produced by an analogous mechanism.

Besides inanimate bodies, solid, fluid or gaseous, which preternaturally enter the cellular texture, we find there real animate bodies, worms. The *cysticercus cellulosæ,* the *filaria medinensis* or hair snake properly called, and the larvæ of the *oestrus* have been met with by different observers, not only below the skin, but in the interstices of the muscles, in the substance of the pia mater, and even upon the bones.

Various natural textures of the economy are preternaturally developed in the cellular system.

Osseous and cartilaginous transformations and productions are not rare in it; they are observed particularly in the cellular texture which exists in the neighbourhood of the serous and synovial membranes, sometimes even in that which penetrates the substance of the organs, and less frequently in the sub-cutaneous cellular texture. The fibrous texture frequently appears also in the lamellated texture ; we find examples of it in the parietes of

certain cysts, in the production of fibrous tumours, &c. It is to the transformation of this texture into serous membrane that must be referred the production of most cysts, which are developed at its expense. Motion also produces in some places preternatural serous membranes. *(Vide Serous System.)* Abscesses and old fistulas are lined by a membrane which has some analogy with those of the mucous system.

All these various forms, which the cellular texture can assume, ought not to surprise us, when we recollect that the fibre which constitutes it makes at the same time the base of most of the organic systems.

Degenerations, properly so called, are very common in the cellular texture; the more abundantly an organ is provided with it, the more is it exposed to this kind of affections. But they do not only attack this texture, when it is found combined in the different organs with the other elements of which they are composed, but the loose cellular texture that surrounds them is equally subject to them; that even, which, being accumulated in certain regions, seems entirely insulated there, is not exempt from them. Thus in the white swellings of the articulations, in the cancerous affections of the glands and of the viscera, the lamellated texture is almost always confounded with the diseased parts which it covers and is degenerated like them. Thus we find, in the places where the cellular texture is accumulated, schirrous, carcinomatous, tubercular and fungous masses, in which this texture alone appears to be altered.

III. *Alterations in the Development.*

The cellular texture can itself be developed preternaturally; it is met with in a great number of morbid

productions; many of them are essentially formed of it. This texture takes the place of atrophous organs; it is produced on the surface of suppurating wounds, in which it constitutes the membrane of the fleshy granulations. The mechanism of its formation under these circumstances is far from being perfectly understood, to say that it is an extension, an elongation of the cellular texture which pre-existed in the part, is not explaining how this sort of exuberance, is developed. Every thing leads us to believe that it is a new texture formed, as in the union of simple wounds, by means of an exudation of an albuminous nature or at least of one capable of concretion. What is observed in fact in a solution of continuity which is cured by cicatrization? The hemorrhage ceases, the blood is replaced by a serous fluid, the wound is covered by a soft whitish layer, at first feebly adhering to it; soon this substance, to appearance inorganic, is penetrated with vessels, becomes more dense, it cannot be separated but with difficulty from the subjacent parts and it takes all the characters of the membrane of the fleshy granulations. Has not this series of phenomena the greatest analogy with what takes place on the surface of inflamed serous membranes? Do we not see in both cases an effusion of lymph capable of concretion, the result of which is the production of a false membrane, which, by becoming organized, is changed into real cellular texture?

ADDITIONS

TO THE

NERVOUS SYSTEM OF ANIMAL LIFE.

Nerves which the Brain furnishes.

Page 172.—" The cerebrum furnishes but two nerves, the olfactory and optic; .... their softness is greater than that of most of the other nerves."

The optic nerve is placed at the present day, among those of the medulla oblongata. It derives its origin in fact from the tubercles which surmount the posterior part of the tuber annulare; tubercles called *quadrigemina* in man, though there are but two of them in many animals, and the size of which is such, in many classes, as birds and fishes, that they might be taken for cerebral hemispheres. These tubercles which deserve to be called *optic* rather than the *thalami* to which this name has been given, are evidently a dependance of the cerebral protuberance, and not of the cerebrum, as some anatomists have said. As to the olfactory nerve, its origin is not

yet well known. Animals exhibit it to us coming out of an accessory part which their cerebrum has, from a kind of lobe superadded to its hemispheres. This lobe, sometimes more considerable than all the rest of the cerebrum, is formed by an elongation of the peduncles which extends forwards. But nothing similar appears to exist in man. The olfactory seems to be detached from the surface of the brain itself. Yet some anatomists say that they have traced it further. M. Chaussier makes it arise from the corpus striatum, and others have seen it continued with the peduncles. In this last hypothesis, and by reasoning from analogy, some consider the pulpy swelling of this nerve as its real point of origin. This swelling would form part of the cerebrum and represent the olfactory lobe of animals; the nerves of this name would only commence at the ethmoidal canal.

Origin of the Nerves.

Page 173.—" It is clear, that the nerves do not arise deep in the cerebral substance, at least in an apparent manner, but take their origin from its external surface."

Accurate researches have demonstrated, 1st, that we can trace, to a certain depth, the filaments of the origin of most of the nerves both spinal and cerebral; 2d, that these nerves do not arise from the medullary substance, which they only pass through, but from the grey substance, which is always found accumulated in the neighbourhood of the places where they are sent off, as Vicq-d'Azyr has already remarked. These truths have been placed beyond a doubt by the recent labours of M. Gall.

The mass of grey substance which occupies the centre of the spinal marrow forms there on each side, when the

marrow is cut across, two arched striæ. From the median line, where these striæ are united, they go obliquely outwards, one before and the other behind, and are evidently continued with the anterior and posterior branches of the spinal nerves. In other words, this grey substance represents in the marrow two species of prismatic cords united at the back by one of their angles, and continuing with the nerves by the other two.

In examining attentively the cerebral nerves at their origin, we perceive moreover more or less distinctly the grey substance which furnishes them. Sometimes this substance is superficial, as at the origin of the olfactory and optic nerves, and nothing is more easy than to see the medullary filaments separating from it. Sometimes it is deeply situated, and it is only by a careful dissection that we can discover the true origin of the nervous fibres, which, breaking off on a level with the cerebral substance, seem to arise from this place. Sometimes the nerve is strengthened in its course by the addition of new filaments which come to it from the neighbouring parts of the cerebral substance; this is the case with the optic. There exists also some of the grey substance at the origin of these filaments.

Nevertheless we ought not to conclude from these facts that the grey substance produces the nervous filaments, and it is no doubt in a figurative sense that M. Gall has called it the *originating*, or *nourishing* substance, or *matrix* of the nerves. The word *origin*, as Bichat has observed, must not be understood literally. Besides, because the grey substance is met with wherever the nervous is continued with the nervous centres, it does not follow from that, that one is made by the other; the union of these two substances may have very different uses.

Crossing of the Nerves.

Page 174.—" I do not believe that with our present knowledge we can explain this phenomenon" (the crossing, in paralysis from compression of the brain,) " and the anatomical opinion pointed out above" (viz. that the nerves cross at their origin) " is contradicted at the first sight."

If in fact the crossing of the nerves at their origin has been rather supposed than seen, it is not so with that of the spinal marrow which Petit, Lieutaud, Winslow and other anatomists have admitted. Raise carefully the pia mater which covers the extremity of the medulla oblongata, afterwards separate the anterior pyramidal eminences, and you will distinctly see the medullary filaments of the right side going to the left, directed obliquely towards the cerebrum; and vice versa, those which compose the left pyramid ascend and go to the right side. Above this crossing in the form of a mat, the pyramids are united by transverse fibres, which should not be confounded with the oblique ones here referred to.

This arrangement enables us to explain how the lesions which exist above this place, either in the cerebrum or the medulla oblongata, produce paralysis in the side opposite to the affected one. On the contrary, when the spinal marrow is divided transversely and on one side only, the same side is paralyzed, as Yelloly has proved; Galen had before noticed this fact.

It has been said that in some cases, paralysis and the cerebral injury which was the cause of it, have been seen to occupy the same side of the body, the motions being preserved on the opposite side. It is hardly possible to

explain these insulated facts, at least to admit the explanation which M. Gall has given. This explanation is founded upon this, that among the fasciculi which go from the spinal marrow to the cerebrum, the anterior pyramids alone cross. Now, by supposing that the cerebrum should be injured in a point where its fibres are not continued with those of the pyramids, the phenomenon arising from the crossing will not take place. It would remain to be known if this exception is met with in the cases observed; this has not been stated.

Chemical Composition of the Nervous System.

Page 196.—" This hardening, the effect of acids, of boiling and of alkohol .... approximates this substance" (the cerebral) " to the albuminous fluids. I say that it approximates it, for there are still great differences between them, of which, I think, we know but little."

The cerebral substance has been analyzed by modern chemists. M. Vauquelin has found in it, 1st, two peculiar fat substances united to a certain quantity of phosphorus; 2d, water which forms 0,80 parts of it; 3d, albumen; 4th, osmazone; 5th, sulphur; 6th, phosphate of potash, lime and magnesia; 7th, some appearances of the muriate of soda.

Of the two fat substances, one is white, shining and of a soft and viscid consistence. It is distinguished from fat, properly so called, by its crystalline appearance, by the facility with which alkohol dissolves it and by the black colour it assumes when heated. When burnt, a charcoal is left for a residuum which contains phosphoric acid. It constitutes 0,45 of the substance of the cerebrum. The other fat substance is much less abundant in

it, and differs from the preceding only in having a red colour, a strong odour and taste and being still more soluble in alkohol.

The same principles are found in the spinal marrow; the proportion of fat substance is greater in it; there is, on the contrary, less albumen, osmazone and water. The medulla oblongata exhibits the same differences.

It is the albumen which predominates in the nerves; the white and red fat substances are in very small quantity in them.

Peculiar Texture of the Nervous System.

Page 199.—" In general I think that this substance," (the nervous) " as well as the cerebral, would be ranked, if they were deprived of the vessels that run through them, rather among the fluids than the solids, or they would form a medium of connexion between the two."

We ought to distinguish in the texture peculiar to the organization of the nervous system, the two substances which it contains, the white and the grey.

The white or medullary substance is evidently composed of fibres in many parts of the cerebrum; such as the corpus striatum, the corpus callosum, the tuber annulare, the elongations which it sends to the cerebrum and to the cerebellum and the termination of the medulla oblongata. Except this small number of exceptions, the cerebral mass, when cut in all directions, seems to be perfectly homogeneous, and is uniform in appearance except from the red points which are the orifices of the divided vessels: there is no very distinct filament seen in it. Yet we shall be compelled to admit the existence of filaments, for, if we endeavour to tear the white sub-

stance, we shall see that it resists more in one direction than another. But if instead of thus dissecting the cerebrum by cutting it irregularly, we attempt to trace the course of the apparent fibres to its inferior part, by gently scraping the cerebral substance in the direction of these fibres, we shall soon acknowledge that they extend much further than we at first thought. We shall see them penetrating the cerebral mass itself, becoming stronger there and contributing by their union to form those eminences that are so numerous, those fasciculi so variously formed, between which we do not at first find any kind of connexion.

It was by pursuing this method that Malpighi discovered the real structure of the cerebrum, so well developed since by Reil, M. Chaussier and M. Gall. Nothing is easier than to verify the facts stated by these anatomists, provided we could have a brain of a certain consistence, such as would be that of a living animal. We can render it firmer by the means of reagents. We cannot say that it is their action which produces an appearance of fibres, for with very dissimilar liquids, the results are uniform. The following is the arrangement which is observed:

The fibrous fasciculi which constitute the termination of the medulla oblongata, having arrived at the inferior edge of the tuber annulare, separate. The posterior bodies go to the cerebellum in which they terminate. The anterior pyramidalia and the cords coming from the corpora olivaria, traverse the tuber annulare by passing above its transverse fibres. They plunge into the grey substance which they there meet with, then come out in front of the pons varolii, and are extended on each side, to form the peduncles or crura of the cerebrum; the medullary filaments are very distinct in these elongations,

because they are mixed with the grey substance which insulates them. These filaments become larger, when they are extended across the optic thalami and the corpora striata. Beyond these eminences, the fasciculi which come from the medulla oblongata spread out in each of the cerebral hemispheres; their fibres go in all directions and extend even to the circumference of the organ. Those which occupy the posterior and superior part of it come from the corpora olivaria, whilst the pyramidalia form especially the anterior and inferior part of the cerebrum.

On the other hand, the fibres which unite the hemispheres at the median line, as those of the corpus callosum, the fornix and the anterior and posterior commissures, do not appear to be continued with the fasciculi coming from the medulla oblongata. Hence the distinction of the diverging and the converging fibres, or apparatus of formation and apparatus of union, (Gall) called also *system of the crura of the cerebrum*, and *system of the corpus callosum*, (Reil.) Anatomists are not agreed respecting the origin of the fibres of the second order; perhaps it differs in each of its parts.

The cerebellum has also two orders of fibres. The greater part of its mass is derived from those which come from the corpora posteriora, and which are much increased in the grey substance of these bodies. Some come from the fasciculi which the cerebellum receives from the tubercula quadrigemina; they are those which form more especially the median lobe, or the superior vermicular eminence, as Vicq-d'Azyr first demonstrated. Finally others, analogous to the commissures of the cerebrum, unite the two lateral lobes by forming what is called the Pons Varolii, whether these fibres arise, as M. Gall thinks, from the external grey substance, or whether they are

nothing but the diverging fibres curved, as is the opinion of Tiedemann.

The medullary substance of the nerves is formed, like that of the cerebrum, of fibres in juxta-position. According to the experiments of Reil, this fibrous appearance is not owing to the presence of the neurilemas which can be destroyed with acids without altering the filamentous texture.

The white substance, examined in the spinal marrow is also composed of filaments; Vieussens was among the first who noticed this arrangement, since very well observed by Monro and M. Gall. The arrangement of the fibres is here very remarkable. The pia mater is buried in the anterior median furrow, and continued behind into the substance of the spinal marrow, almost to its posterior face; from each side of this elongation many grooved filaments are detached, directed from above below, which contain the medullary substance. By subjecting the spinal marrow to the action of the alkalies, this substance is destroyed, and the membranous tubes remain untouched. There is then a great analogy in this respect, between the structure of the spinal marrow and that of the nerves; the pia mater performs here really the part of the neurilema. If the consistence of the spinal marrow is increased by acids, the fibres which compose it are easily distinguished. Most of them are longitudinal, and represent an infinite number of small lamina, formed themselves of delicate filaments; some are transverse. These last are seen especially in the depth of the anterior median furrow; the posterior, on the contrary, exhibits only longitudinal fibres. All these fibres unite and anastomose in different ways, as the nerves do.

The grey substance does not form like the white a continued whole; sometimes exterior to this last, sometimes

intermixed with its fibres, it is in general met with, wherever the medullary filaments become larger. It is found in the whole circumference of the cerebrum, and forms what is called the *cortical substance ;* it composes at the base of this viscus many masses which have been compared to ganglions. It occupies the centre of the spinal marrow ; it has been said that the nervous extremities are provided with it, but this has by no means been demonstrated.

The colour of this substance is generally of a brownish grey, in some parts yellowish and even black ; the diversity of these shades is attributed to the greater or less quantity of blood which it receives. Its density is less than that of the white substance. Its structure is but little known ; some have admitted that there were fibres in it ; Vicq-d'Azyr has traced filaments coming from the medullary substance. It contains many blood-vessels, more even than the white substance ; but it is not entirely formed of them, as Ruysh thought. His belief arose from the fact that by washing this substance, after having injected it, there was finally nothing left but vessels ; but it is evident, that in this case, as Albinus observes, the washing takes away every thing that is not vascular or capable of injection.

The nervous texture, examined by the microscope appears to be composed of globules ; this has been observed a great number of times. Prochaska, Wenzel, Barba, and recently M. Bauer have paid particular attention to these globules. In order to see them, it is necessary to mix with water a small quantity of the white substance and place it in the focus of a strong lens. Their size has been very differently estimated ; it has been compared, as well as their appearance, to that of the colourless globules which are found in the blood. Prochaska thinks them

smaller than those of the blood. The Messrs. Wenzels brothers think that they are hollow. They are not destroyed by maceration nor by reagents. Their union appears to be intimate ; we are ignorant of the mode of it ; it is supposed that there exists between them a very delicate cellular texture, containing vessels ; others have thought that they saw there a fluid and viscid matter. Sometimes arranged in a row, they form straight parallel lines ; sometimes they are found confusedly heaped together, as Prochaska says he has observed in the grey substance. It is no doubt from this difference that Carus, rejecting the distinction of white and grey substance, says that the organization of the nervous system exhibits but two essential modifications ; in the one, which constitutes the gangliform or central masses, the nervous substance is composed of irregularly scattered points ; in the second, which comprehends the nerves, they are regular and constant lines. From this difference of organization, he deduces the differences of action of the two systems, the first being able to act by irradiation, whilst the other is limited, in this respect, to the direction of its length.

The colour of the grey substance appears to reside less in the globules themselves, than in the species of soft cellular texture which separates them. To remove the colouring matter from this substance, it is merely necessary to put it in tepid water in thin slices. Sublimation produces in part the same effect. This matter does not then seem to be inherent in the globules.

Development of the Nervous Centres.

Page 237.—" The extreme softness of the brain renders its dissection very difficult in the fœtus."

Tiedemann has succeeded in overcoming this difficulty. This author has traced all the changes of the development of the encephalon, and has described them with great precision. Carus, Doellinger and Ackermann, had previously stated some facts relative to the development of the nervous system. M. Serres has recently been engaged in this subject.

The brain scarcely exists in the beginning; in an embryo of six weeks, there is found only a flattened cord which represents the spinal marrow, and the superior extremity of which is slightly enlarged.

In pregnancy of two months, the brain is still but very little developed compared with the spinal marrow; it is then composed, 1st, of the cerebellum, the transverse extent of which is considerable; 2d, of the cerebrum, which is very small; 3d, of a third portion placed between the two first, and the size of which exceeds that of the cerebrum; this part appears to correspond to the cerebral protuberance, or more exactly to the tubercula quadrigemina. M. Serres has ascertained that it is formed in man and animals, before the cerebrum and cerebellum, and immediately after the spinal marrow.

The relative dimensions of these organs afterwards change. The cerebrum grows more and more; towards the fifth month, it already covers a part of the protuberance; at the sixth, it extends even upon the cerebellum, which it gets beyond at the seventh. The other parts on the contrary increase less in proportion, especially that which corresponds to the protuberance.

The whole encephalon is divided at first into two parts by a longitudinal furrow; this arrangement is observed in fœtuses of seven months. The two halves afterwards approximate and finally unite, except in some places, where the interstices form cavities; so that at three months

we discover instead of a longitudinal division, 1st, the third ventricle; 2d, the aqueduct of Sylvius which is, at this period, a great cavity continuous with the middle ventricle; 3d, the fourth ventricle. Afterwards the cavity of the aqueduct is gradually contracted; it is nothing but a canal towards the seventh month. The two other cavities undergo no ulterior changes but those which belong to the development of the parietes.

In the first periods of gestation, the conformation of the cerebrum is very simple; there then exists but the base of this viscus, and that even is very imperfect. We see in a fœtus of seven weeks only the thalami nervorum opticorum, the corpora striata are hardly visible; a sort of membranous part seems to indicate the place of the hemispheres.

It is in fact under the form of a membrane that each hemisphere is developed; this membrane, originating at the base is bent before and behind, as it is seen at the ninth week, and extends to the corpora striata and the thalami nervorum opticorum; the space which remains below them constitutes the lateral ventricles. The anterior lobes appear first; they are very visible at three months. The corpus callosum is formed almost at the same time, by the junction of the two membranes of the hemispheres; it occupies at first only their anterior part, and is extended backwards as they grow; at six months it only extends half their length. The cornua Ammonis appear with the corpus callosum, as well as the fornix, the mamillary eminences, the posterior commissure, and the peduncles of the cerebrum, shortly after is discovered the hippocampus minor and the groove which gives rise to it, the pineal gland and its peduncles, then the anterior commissure, the septum lucidum and its cavity, which then communicates with the third ventricle, between the

two pillars of the fornix; in the last place, the semicircular band, the plexus choroides and the infundibulum; this successive evolution is completed towards the seventh month.

All these parts have not the same appearance in the different periods of their development; thus the fornix is at first composed of two cords insulated in their whole extent; thus the corpora striata are for a long time larger than afterwards and of a different form. At the third month, the lateral ventricles are open at their internal and posterior part; we can, even towards the fourth month, penetrate into their interior by turning back the membrane which forms them. At the fifth, their extent is considerable, owing to the small degree of thickness of their parietes; they progressively diminish, as these parietes are developed. The surface of the cerebrum is smooth in the first months; soon the fissure of Sylvius is visible, some inequalities appear, and the circumvolutions are formed at the seventh or eighth month.

The cerebellum, in an embryo of seven weeks, appears like a fine lamina, stretched horizontally from each side of the fissure which divides the encaphalon at this period, and continuing on the one hand with the spinal marrow, and on the other with the cerebral protuberance. This lamina, bent backwards, forms towards the fourth month a great cavity continuous with the fourth ventricle; it afterwards becomes thicker and the cavity diminishes. This is reduced to the fourth ventricle towards the fifth month; transverse furrows then divide the cerebellum into five lobes. The structure of this viscus is more and more developed. The lamina are very distinct at the seventh month.

The cerebral protuberance would be better called in the beginning the mass of the tubercula quadrigemina; its

inferior part or Pons Varolii is wanting, there only exists the lamina which is afterwards surmounted by the tubercula. This part is hollowed out from the aqueduct or cavity of Sylvius, and exhibits a groove which is the trace of the division which is early observed. The tuber annulare, properly so called, begins to appear in the course of the fourth month, but its development is not complete till the seventh; it is also at this period only that the tubercula appear.

The spinal marrow forms at first a species of ribbon, divided by the common fissure and occupies the whole length of the vertebral canal, extending to the os coccygis. In the third month, its edges turn over behind and unite, by which means a canal is formed which is continuous with the fourth ventricle. At twelve weeks, the termination of the medulla oblongata is very evident; we see there the posterior pyramidalia which are continued with the cerebellum and the anterior ones making a continuation with the peduncles of the cerebrum. It is at the third month, according to M. Serres, that the medulla is contracted and reaches by degrees to the level of the second lumbar vertebra. At the fifth, we distinguish the cervical and lumbar enlargements as well as the cauda equina; the canal of the medulla still evidently communicates with the fourth ventricle.

Such are the principal changes which take place in the conformation of the encephalon. Those which it experiences in its texture are not less remarkable.

All is fluid and homogeneous in the beginning. The white substance afterwards becomes more distinct. Its fibrous structure is early manifested; the interlacing of the pyramidalia is seen at the eighth week, according to M. Serres. Tiedemann has seen at the fourth month fibres in these pyramidalia, and shortly after in the fasci-

culi of the olivaria; these fibres can be traced in the thalami nervorum opticorum and in the corpora striata; they extend out in rays to form the membrane of the hemispheres. These diverging fibres become more and more evident; at the sixth month, they are almost naked on the parietes of the lateral ventricles. At the same period, the cerebral substance has appeared, through the microscope, to be composed of globules immediately below the pia mater, and of fibres lower down. At the seventh month, a section of the ventricles exhibits very evident layers of radiated fibres. New ones are afterwards produced which form the circumvolutions; they seem to arise from the external pia mater and are joined at a right angle to the first; these are called the *converging* fibres. At the ninth month, the organization is completed.

The grey substance does not appear till a long time after the white. It is not until from the sixth to the seventh month that the cords of the corpora olivaria form real eminences, by the development of this substance in their interior; the pyramidalia are enlarged a month sooner. In the last periods of gestation, the canal of the spinal marrow is also filled with a grey substance; the same substance is developed in the circumvolutions of the cerebrum, in the cerebellum, &c.; its colour is not very evident in all these parts till the ninth month. M. Serres, as well as Tiedemann, thinks, that the white substance arises before the grey in the spinal marrow; but it is not the same, according to him in regard to the cerebrum; he considers the optic thalamus and the corpus striatum as entirely formed of grey substance in the beginning; the white is not developed till afterwards. The grey and white substances are always preceded in their development, by that of the red vessels in the places where they are produced.

Development of the Nerves.

Page 237.—" The nerves of animal life have a development proportional to that of the brain."

This relation is very different in the beginning, for we distinguish the spinal marrow and the brain, whilst most of the nerves are wanting, on account of the late development of the other systems. We know not if it be the same with the heart and the digestive canal, which are formed almost as soon as the nervous system. M. Meckel thinks that the nerves of these organs, like those of the other parts, do not appear until after the nervous centres. Yet the great sympathetic appears to exist very early, and is developed if not sooner, as Ackermann thinks, at least at the same time as the brain and spinal marrow. Another exception to this rule is, that we find, in a month after conception, the intercostal nerves as well as the vertebral ganglions ; now, neither the brain nor the marrow are distinct at this period. Perhaps the filaments of the great sympathetic being more transparent escape observation. This nerve is found in fœtuses which are born entirely destitute of all the parts of the encephalon.

In a fœtus of three months is seen distinctly the optic and olfactory nerves. In the following month the fifth pair is visible. At the seventh, the origin of all the nerves is seen perfectly well. The olfactory nerves are at first very large, they begin to diminish at the sixth month. The spinal nerves are, like the cerebral, very distinct at their origin before the grey substance is discoverable, (Tiedemann.)

The texture of the nerves does not become apparent, until their vessels are developed.

MORBID ANATOMY OF THE NERVOUS SYSTEM OF ANIMAL LIFE.

I. *Alterations in the External Forms.*

Organic diseases often increase the size of the nerves, as Reimarus has observed with regard to white swellings. Neuralgias are sometimes accompanied with the same alterations. Cotugno has found the sciatic, in the neuralgia of this name, as if it were infiltrated with gelatinous matter. Fat also may accumulate between the nervous fibres. A sort of atrophy of the nerves is on the contrary the result of some paralyses or of pressure too long continued ; thus in amaurosis, the optic nerve is often hardened like horn, and gradually reduced to its neurilema ; thus various tumours produce atrophy of the nerves which they compress. The brain appears to have experienced a diminution of size in the cases stated by Littre and Sabatier, in which after a powerful concussion, this viscus, they assure us, no longer filled the cavity of the cranium. M. Cruveilhier has seen the same thing in the dead body of an idiot.

The nerves have sometimes appeared to be less consistent than in the natural state. Weinhold, as cited by Hufeland, has found in them after typhus, a peculiar softness and flaccidity. They exhibit, it is said, this alteration in dropsies and fatal hemorrhages.

The brain presents the two extremes in relation to its consistence ; its hardness is seen in mania, idiocy and epilepsy ; its softness, observed at first in the same circumstances, has been since seen in ataxic and adynamic fevers and in hydrocephalus. M. Rostan has given some

new details upon this last alteration and upon the disease which results from it. In the cases which he has observed, the softening varies much in relation to its extent, depth, intensity, colour of the cerebral substance, &c. M. Lallemand has also described this alteration.

The spinal marrow loses its consistence in spina-bifida. Softness of the marrow has recently been met with by M. Scipio Pinel, in cases where it appeared to have produced peculiar symptoms. Frank has found this organ hardened.

Tumours, such as aneurisms, situated upon the course of the nerves, may displace, distend and flatten them. It is known how they yield under these circumstances. Perhaps their elongation may be in great measure attributed to the kind of unfolding which they undergo. The nerves are in fact folded in the natural state ; their surface is, at it were, wrinkled ; by examining it attentively, we can discover there an innumerable quantity of small striæ, transverse in most, oblique in others, interlaced in some, forming zig-zags, spirals, &c. These striæ are remarkable for their yellowish or fawn colour, which forms a contrast with the pearl white which the nerve preserves in their interstices. This is at first view so striking, that we only see at first a multitude of white threads, arranged precisely like the striæ ; the deeper colour of these last prevents them from fixing the attention so much. Now these striæ are effaced by extension and reappear when it is taken off. The same thing then should take place in the cases of which we have spoken.

The brain and spinal marrow are exposed to compressions, which alter more or less their form. The marrow in particular undergoes at times remarkable bendings; its functions are not always deranged by them. The form of the brain also experiences very great changes in hydrocephalus.

II. *Alterations in the Organization.*

Inflammation of the nerves is a very rare disease. Can we give this name to the sanguineous engorgements, vascular dilatations, which their surface exhibits in certain cases, in typhus, for example? To be certain of the nature of these engorgements, it is necessary to destroy the neurilema by an acid, and observe what is then the colour of the medullary substance. Reil, who has followed this course in many cases, has found the nervous medulla of a red colour and evidently inflamed. Suppuration, gangrene and ulceration can affect the nerves, but they never do primarily. The brain, on the contrary, is often the seat of purulent collections; gangrene sometimes seizes upon it, as is seen particularly after wounds of the head, when this viscus is injured or merely laid bare; we remove it then by spoonsful, in the form of an extremely fetid, grey sanies. False membranes are produced in the brain, especially upon the parietes of the abscesses which occupy its interior. They are susceptible of being organized and becoming vascular.

The mode of reunion of the nerves, when they are divided, has been a subject of discussion. Arnemann has described it with much care. Shortly after the division, the superior end swells at its extremity, and forms a kind of greyish knot, elongated and very hard; the inferior swells also but less, then both unite and their separation disappears. The knot continues and often even acquires a consistence almost cartilaginous. The portion of the nerve which is below also undergoes some changes, though all observers are not agreed upon this point. In general it becomes more slender, is withered, as it were,

its colour changes and its folds are effaced. As to the nature of the cicatrix, most authors think it nervous, and as such, capable of re-establishing the continuity of the nerve in relation to its functions. Haighton has even made experiments upon this subject, which appear to be decisive. After having cut in a great number of dogs the two nerves of the eighth pair, either at the same time, or one after the other, but with only a few days between, and having thus ascertained that death was uniformly the consequence, he allowed in another dog six weeks to elapse between the section of the two nerves. The animal recovered perfectly. We may conclude from this, either that the cicatrix of the first divided nerve transmitted the nervous influence, or that the functions of this nerve were re-established between the first and second operation, by means of anastomoses. To remove every kind of doubt, the two reunited nerves were cut a second time in the same animal and he died. Then it was by means of the cicatrix that he had lived. Arnemann denies to the cicatrices of the nerves the property of the nerves ; they are, according to him, purely cellular, and when the functions of the nerve are re-established, it is because there is an immediate reunion between the two ends ; but when these ends are separated, or there is a loss of substance, he denies that a regeneration can take place. The knot which is produced appears to him to be incapable of replacing the nervous substance ; he has seen it arise from the cellular texture and only gradually unite with the two ends of the nerve. Yet Fontana, Michaëlis and Mayer say, that they have traced nervous filaments through the regenerated portion. These filaments are evidently continued with the nerve. Treated with nitric acid, far from being destroyed by it, they are hardened, like the medullary substance under similar circumstances, (Mayer.)

Now these physiologists have removed one, two, six lines, and even an inch of the length of the nerve.

In amputations, the superior end, which forms part of the stump, swells as in the preceding case. M. Lobstein has given new details upon this fact, which had been observed by Vanhoorn.

Lesions of the brain appear, like those of the nerves, to be followed by a sort of regeneration. Solutions of continuity of another kind have, moreover, their seat in this viscus. These are the internal lacerations, in consequence of which the blood is effused either in the cerebral substance, or in the ventricles; concussions of the brain and apoplexy offer examples of them. The blood then becomes a foreign body, whose presence occasion serious difficulties. These difficulties should also be in part attributed to this, that the cerebral substance is disorganized in a greater or less extent; its colour is a yellowish red, and its texture is softened. When death is not the consequence of it, a membrane is formed around the blood, this fluid is absorbed, and there remains only a serous cyst, which also finally disappears. The spinal marrow is likewise liable to experience this alteration; it was converted into a sort of porridge infiltrated with blood, in a case observed by M. Gaultier de Claubry.

The nerves are hardly ever ossified. The brain is so sometimes; various instances of which are found in authors. They are almost always osseous productions, for the most part loose, rarely adhering closely to the cerebral substance. Tumours, which seem to belong to the fibrous or cartilaginous textures, are developed in the nerves, the brain and even the spinal marrow. They are hard, greyish and separate the medullary fibres, which take no part in their development. M. Dubois and Home have extirpated these tumours. Some refer them to the cancer of

the nerves. Cysts are formed in the brain; we have already pointed out one of the circumstances under which they are produced. They are often taken for hydatids. These are rare in man, though they are sometimes found.

The scrophulous affection is the most common in the brain. It appears under the form of tubercles of very various size, round, greyish or yellow, soft and brittle, the number of which is sometimes very considerable. A cellular membrane surrounds them. Cancer of the brain has also been observed. Finally M. Meckel speaks of fungous and spongy tumours, analogous to the productions called erectile, and which have their seat in this viscus. They are extremely rare in it. The nerves are foreign to almost all these alterations.

III. *Alterations in the Development.*

Clarke has given, in the Philosophical Transactions, the description of a fœtus so imperfect, that it had no nervous system. It is the only fact of the kind known. We often meet with acephalous fœtuses, or rather aencephalous ones, that is to say, destitute of a part or of the whole of the brain. The spinal marrow exists in the greatest number of cases, but in some it also is wanting. Examples of this last kind are cited by M. Lallemand in his inaugural dissertation. I have myself seen some. In these cases, the peculiar membrane of the spinal marrow forms the parietes of a cavity which contains a liquid, and the nerves are implanted as usual into this membrane. Otto, (*Treatise on Morbid Anatomy,*) mentions many cases in which the optic nerve and other nerves of the senses were wanting in individuals destitute of sight, hearing, &c.; the rest of the nervous system was as in the natural state.

Anomalies are quite rare in the nervous system, especially in the portion of it which belongs to animal life. Yet the brain sometimes exhibits an inequality in the size of its lobes. Bichat was himself a remarkable example of this. Hydrocephalus is most often a congenital affection. The canal of the spinal marrow sometimes continues until after birth, as M. Portal and others have seen in hydrorachitis. The nerves vary a little in their distribution, though it is more uniform than that of the arteries.

The nervous texture is never preternaturally produced, if it be not in the case of the wound of which we have spoken above.

ADDITIONS

TO THE

NERVOUS SYSTEM OF ORGANIC LIFE.

Insulation of the Great Sympathetic.

Page 252.—" It is evident that a line of demarcation separates the nerves of the ganglions and those of the brain, and that the method is inaccurate which considers them as forming a single nerve, arising by some origin from this last."

The great sympathetic has always been a subject of discussion among anatomists. Haller, Zinn, Scarpa and Legallois have maintained, that it depended on the brain and the spinal marrow, like the other nerves, and that, like them, it only transmitted an influence which it receives from these parts. Many other physiologists, on the contrary,

think that this nerve is insulated, by its arrangement as well as by its action, from the rest of the nervous system. Authenrieth makes it come from the general nervous system; but he supposes that as its filaments pass through the ganglions, they are less and less subjected to the cerebral action. According to Reil, the great sympathetic has only filaments of communication and no origin, but it enjoys the property of a *semi-conductor*. Gall, like Bichat, makes a multitude of insulated systems of it, which arises from the manner in which he has considered the nervous system in general. Finally J. F. Meckel has adopted a sort of mixed opinion according to which the great sympathetic, though insulated, may depend, to a certain extent, upon the central organs.

It would be superfluous to give in detail here the reasons alleged for and against these opinions; we shall content ourselves with pointing out the principal. Nothing prevents us from calling, in the great sympathetic nerve, points of origin, the points of communication of this nerve with the spinal marrow and the brain, if we recollect what ought to be understood by the term *origins* in the nervous system; they are the central extremities of the nerves, those which are the nearest the nervous centres. All that has been said to prove that the ganglions are these centres, only shows that there are great differences of organization in the great sympathetic and the other nerves. It is unimportant whether this series of ganglions and intermediate cords is considered as a single nerve, or as so many insulated parts, united by anastomoses. But it is not so, to know if this system be really independent of the cerebral, or if, as Legallois pretended, it be on the contrary from this last that it derives all its influence. We know the experiments of this physiologist upon animals from which he removed the brain and

afterwards supported life by means of artificial respiration. The destruction of the spinal marrow constantly produced death by the sudden cessation of the pulsations of the heart. When the spinal marrow was destroyed only in part, the pulsations were only weakened, cutting off the limbs did not occasion the blood to flow, but life still continued. Legallois concludes from them, 1st, that the heart receives the principle of its action from all the points of the spinal marrow, through the medium of the great sympathetic ; 2d, that the integrity of the spinal marrow is indispensable to the functions of this last. But we have seen monsters born without a spinal marrow, and yet they lived in the womb of the mother. Dr. Wilson Philip having repeated the experiments which we have just cited, found that the pulsations did not cease immediately after the spinal marrow had been removed ; they ceased quicker when it was violently torn out than when it was taken away with care. The animals, subjected to these experiments, resist also in general so much the more in proportion as they are younger. Finally, in many fishes, carps in particular, Mr. Clift has seen the pulsations of the heart continue notwithstanding the lesion of the spinal marrow. We ought then to have regard, in the conclusions which we draw from this sort of experiments, to the age and species of the animal. We may apply to the spinal marrow, in this last respect, what is elsewhere said of the brain ; it is, that in the inferior animals, the centres are much less necessary to the action of the rest of the nervous system. Their less importance in animals accords with their less development. So in man and the superior animals, the great sympathetic depends so much the less on the brain and the spinal marrow, as these parts are themselves less developed, as, in a word, the individual is younger. It is in this way, and not in

an absolute manner, that we should resolve the question proposed.

Structure of the Ganglions.

Page 258.—"I think then by admitting, even to a certain extent, the internal arrangement that this author (Scarpa) has observed in the ganglions, we cannot describe these organs in the point of view in which he has presented them."

The observations made by Scarpa have been repeated in our time. The ganglions are composed, as this anatomist has demonstrated, of two very different substances, before pointed out by Winslow.

1st. It is almost always easy to trace in the ganglions the nervous filaments which emanate from them; these filaments preserve in them their cylindrical form, and white colour, and are easily distinguished from the non-medullary substance, in which they are, as it were, buried. It is often sufficient, according to the remark of Haase, to cut a ganglion to perceive many small white points, which are nothing but the extremities of the divided nervous filaments. These filaments frequently anastomose. In the ganglions situated in the course of a single nerve, their direction is parallel to that of the nerve itself; when, on the contrary, many nerves unite to form a ganglion, there is nothing uniform; the medullary filaments are seen interlacing in all directions, and thus establishing numerous communications between these nerves. Hence the ganglions of the first species are elongated and usually oval, whilst those of the second have a much more irregular form.

2d. The peculiar substance of the ganglions is soft, pulpy, like albumen or gelatine, of a reddish grey, sometimes yellowish, lodged in the interstices of a very delicate cellular texture. It is separated with more or less ease from the nervous filaments which it surrounds; this separation is made with difficulty in the ganglions of the great sympathetic; the medullary filaments are very soft in them and almost semi-fluid at their circumference, so that their external layers are confounded with the grey pulpy matter of which we are treating. The plexuses exhibit nothing similar to this substance; it is this which distinguishes them essentially from the ganglions.

It has been thought that the grey substance of the ganglions was the same with that of the brain; that the use of both was to strengthen the white substance of the nervous fibres. If we examine comparatively a ganglion stripped of cellular texture and a portion of brain in which the grey substance predominates, we shall see that this resemblance does not exist. Without speaking of their dissimilar appearance or of the physical characters which distinguish them, the manner in which they are affected by the various reagents establishes very striking differences between these two textures. This is a fact already recognized by Bichat. The experiments of Wutzer leave nothing to be desired upon this subject; the following is an extract from the comparative table which he has given of the chemical properties of these two substances in his Treatise *de Gangliorum Usu et Fabricâ.*

Treated with cold concentrated nitric acid,	The one, furnished by the cervical or semilunar ganglions, taken from an adult, stripped of their cellular texture and washed in distilled water, experiences the following phenomena; 1st, it undergoes the horny hardening; 2d, at the end of eight days, the horny hardening continues, the matter blackens, and gives, if agitated, and afterwards left to deposit a friable precipitate, in which there is still here and there discovered an appearance of structure; 3d, at the end of a longer time, putrefaction renders it liquid, but it exhales no other odour than that of the acid. The other, taken from parts of the cerebrum or cerebellum formed of three quarters or nearly of grey substance, 1st, is hardened without the horny hardening; 2d, diminishes a little, and takes the consistence of curd; gives, after having been mixed with the liquor by agitation, yellowish albuminous flakes which swim; 3d, the odour of the solution has something similar to that of rancid oil.
By the same acid boiling,	The ganglion is dissolved; the liquor is only a little turbid; by cold a slight precipitate is formed and a small quantity of the matter comes to the surface. The cerebral substance is dissolved but in part, a certain quantity swims upon the liquor; the solution preserves its transparency after it is cold, though an infinite number of medullary particles is seen suspended in it.
By a solution of caustic potash cold,	The first is softened a little; its white filaments disappear; its solution is slow and imperfect. The second is dissolved more easily; one tenth of the matter floats upon the liquid, and does not mix with it.
By a solution of boiling caustic potash,	In one, some filaments remain insoluble; cooling is followed by a deposition formed of globules of a deep red. In the other, the solution is almost complete; by cooling, the surface of the liquid is covered with flakes of a yellowish white.
By boiling alkohol,	The substance of the ganglion is contracted, then dissolved to two thirds; the liquor is turbid. The cerebral matter hardens, and afterwards experiences changes observed by M. Vauquelin; albumen is obtained from it.

Finally, different reagents, which have no action separately on the acid solution of these substances give precipitates when employed together; the alkaline solution presents the same phenomenon, when treated with the muriatic acid, and then with nut galls. These precipitates furnish new characters by the differences which they exhibit in their properties, according as they belong to the cerebral substance or to that of the ganglion.

No doubt a good analysis of the ganglions remains to be made, in order to know precisely the difference which exists between their substance and that of the brain, but these data are sufficient to prove that these differences are real.

According to Scarpa, the peculiar substance of the ganglions is replaced by fat in very fat subjects; it appears that this is not always so. When the corpulency has been the greatest, there has only been found some fatty vesicles under the peculiar membrane of the ganglions (Wutzer). We can conceive that if fat should accumulate there, it would compress the grey matter, and make it disappear in whole or in part.

Uses of the Ganglions.

Page 273.—" Scarpa has collected the opinions of all who have preceded him, together with his own, upon the uses of the ganglions. I refer to what he has said upon this subject."

We can divide into two classes the opinions of physiologists upon the uses of the ganglions.

Some attribute to them purely mechanical ones, as that of facilitating the distribution of the nerves, of effecting the intimate mixture of the nervous filaments, of favouring their union, separation, &c. Meckel the elder, Zinn, and Scarpa are of this number.

The others allow them functions of a higher order, essentially vital, and think that they are designed to moderate and even destroy the reciprocal influence of the brain and the nerves. They thus explain how the organs of the internal life are to a certain extent independent of

the cerebral action, and how the brain in its turn perceives with difficulty the impressions made upon these organs or upon their nerves. In a word, the two lives do not differ more than in their nervous systems.

This idea, obscurely stated in the writings of Willis, F. Petit and Bianchi belongs truly to Johnstone ; most modern physiologists have adopted it. It must be acknowledged that it accords very well with what we know of the structure of the ganglions, and nothing seems more capable of breaking the nervous force than these medullary interlacings surrounded by a substance wholly different from that of the nerves. It is asked nevertheless why some impressions are transmitted notwithstanding the obstacle which the ganglions present to them ; why the vertebral ganglions do not perform in respect to the parts which receive their nerves of them, the same uses as the ganglions of organic life. The first objection has been answered by saying, that the ganglions are imperfect conductors, that they insulate sufficiently to arrest ordinary impressions, but that very acute ones pass through them. Wutzer has seen the action of the galvanic pile upon the lumbar ganglions cause very severe pains, accompanied with convulsive motions, whilst a less degree of irritation produced nothing similar. As to the second objection, it can hardly be combatted except by considering the differences of structure which the ganglions of the spinal nerves exhibit compared with those of the great sympathetic, differences which ought to produce a difference in the functions.

To concentrate the nervous power, to strengthen it, to spread it uniformly upon all the apparatus of organic life and thus to contribute to the regularity of their action, are the uses commonly attributed to the system of which we are treating. It is difficult to assign those of the

ganglions which are found in the posterior branches of the nerves of the spinal marrow.

Ganglions of Animals.

Page 274.—" If the ganglions were not the centres of certain important functions of which we are ignorant, would they be so invariable in the animal organization ?"

It is difficult to determine to what part of the nervous system the organs of this kind belong which are met with in the lowest classes of animals. Worms and insects have insulated swellings, united by nervous cords which go off in the form of rays. In the mollusca, the whole system consists of two great nerves twisted around the oesophagus and an annular swelling which embraces this tube. Blumenbach, Cuvier, Gall and J. F. Meckel admit that these parts correspond with the spinal marrow of the vertebral animals. If, on the contrary, Reil and many others are to be believed, it is the great sympathetic that they represent. Walter of Landshut, assimilates the nervous cords of the mollusca to the nerves of the eighth pair, by comparing to the spinal marrow those of insects and worms. Weber takes the ganglions of the vertebral nerves as the term of comparison. But no one can be exact ; there are too many differences of structure, distribution and functions between these imperfect nervous systems and those of the superior animals. What seems to approach nearest the truth is the term of comparison adopted by Walter for the nerves of the mollusca, which in fact very much resemble the nerves of the eighth pair.

For the same reason, we can hardly give the name of *ganglions* to those swellings, or rather to those irregular

masses, whose nature is still but little known, which appear to take the place, in the inferior animals, of the central organs of which these last are destitute. It is however upon this resemblance that is founded in great part the opinion of those who pretend that the brain and the spinal marrow are assemblages of ganglions ; the proof of it is, say they, that these ganglions are insulated in the inferior animals. We shall not again advert to this opinion, which is contradicted by facts already stated in the organization, development, &c. of the nervous system. M. Serres thinks, like Weber, that the insulated ganglions of the inferior animals answer to the vertebral ganglions.

In animals who, like man, have the spinal marrow enclosed in a bony canal, the system of the ganglions is not by any means developed to the same degree. 1st. Having regard to the whole size of the body, this system is of so much the more extent as the animal is more elevated in the scale of beings, consequently as his organization is more perfect. The eighth pair diminishes on the contrary in the same proportion. 2d. Its development is always in proportion to that of the spinal marrow if we compare both in relation to the whole body in general and not to the brain alone. 3d. The great sympathetic follows also the alimentary canal in its development. 4th. Finally, it is equally connected in this respect with the vascular system.

ADDITIONS

TO THE

VASCULAR SYSTEM WITH RED BLOOD.

Situation of the Arteries.

Page 292.—" Both of them" (the trunks and branches of the arteries) " are covered almost every where by a thickness of parts that protects them from external injury."

Besides, the arteries are almost every where situated in the direction of flexion of the articulations. Thus the aorta is placed in nearly its whole course in front of the vertebral column. Thus the carotids on the anterior part of the neck, the iliacs in front of the pelvis and the subclavians on the inside of the shoulder, all occupy the side towards which the motions are the most extended. This becomes more evident in the extremities. We see, on

the inferior ones, the crural artery at first situated in front of the ilio-femoral articulation, that is to say, in the direction of the flexion of this articulation, turning within and behind to its inferior part, and preserving the same relation with the articulation of the knee. The foot seems at first to form an exception; but this exception is only in appearance, what is called *extension* in this part being really the direction of flexion, if we compare it with the hand, and is besides the direction of the most extended motion. Moreover, it is in descriptive anatomy that we must look to see to what extent every thing, in the neighbourhood of an artery, unites to protect it efficaciously from the injuries which might alter its structure. The arrangement of which we are treating evidently contributes to this object, as has been very well seen by Soemmering. Without it the arteries would at every instant be exposed to stretching, which, by elongating them too much, would produce the double inconvenience of embarrassing the circulation of the blood in their interior, and of producing in their texture, which is but slightly extensible, inevitable ruptures. This situation of the arteries has also another advantage; it follows from it that in flexion, they become much less liable to external injuries; which, in various places, remedies to a certain extent their superficial position.

In the spaces between the articulations, the arteries of the extremities occupy in general their internal side, less exposed than the others to the action of external powers, especially when the limb is in adduction.

Termination of the Arteries.

Page 301.—"The pilous, epidermoid, cartilaginous systems, &c. destitute of arteries, contain only white

fluids in the division of the general capillary system that has its seat in them."

In their termination in different organs, the arteries exhibit also many points for consideration.

1st. The course they run before arriving at it is longer or shorter. We meet in this respect with great differences, which themselves are not uniform, on account of the varieties of origin so frequent in this system. In general the arteries arise at a little distance from the organ to which they are destined. When a contrary arrangement exists, it arises from some local cause. It is thus that the spermatic arteries are, at their origin, very far from the testicles, because the testicles were originally situated much higher up.

2d. The mode of distribution of the arteries, their number and size vary in each organ. There are some which possess many arteries; this is the case even with the greatest number. Others, as the liver, the kidneys, the spleen, &c. receive but a single trunk. The arteries are almost always more or less divided before penetrating the substance of the organs, as we see in the brain, the bones, the muscles, &c. Sometimes they enter them on one side only, and occupy but a very small space on their surface; sometimes almost the whole circumference of the organ gives passage to them. Finally, their size differs in the different organs; it is generally in relation with the nature of the functions which they perform.

3d. The arteries, when arrived in the textures themselves, give rise, by their divisions and subdivisions, to very delicate networks. The form of these networks is not the same every where; Prochaska and Soemmering have pointed it out for a great number of parts. They are trees in the intestine, stars in the liver, tufts in the

tongue, &c.; so that we can by the aid of a microscope, at a single glance, as it were, determine whence the vessels come that are previously injected.

Resistance of the Arteries.

Page 306.—"This longitudinal resistance" (of the arteries) "to distension is less than the lateral resistance opposed to the injection; experiments prove it, and it arises without doubt from this, that no fibre, in the first case, is found directly opposed to the effort."

The cellular coat is in fact almost the only one capable of sustaining an effort which is exerted in the longitudinal direction, whilst the peculiar coat resists with it when the effort is lateral. Besides, the resistance of the arteries is not the same in all; it depends in general on the thickness of their parietes; the cerebral arteries, which have such delicate ones, are so much the weaker than other arteries of the same size. For the same reason, the trunks have more resistance than the branches, these than the smaller branches, &c; only as the thickness does not diminish in the ratio of the capacity, it follows that the arteries the most distant from the part, are, in relation to their caliber, the most resisting. Another cause, according to Clifton-Wintringham, which makes the small arteries resist more, is that their texture is softer and looser.

But few comparative experiments have been made upon the strength of the arterial parietes in the longitudinal direction. The object of those of Wintringham was to ascertain the lateral resistance; it appeared to him to be greater, in relation to the thickness even of the parietes, in the small arteries than in the large ones. The aorta

has also borne a greater effort at its inferior extremity than near its origin. Gordon has endeavoured to measure the effects of the distension; he has ascertained that it requires a greater weight to rupture the external iliac, than the carotid. But in his experiments, the rupture took place where the suspensory cord was attached; there was at the same time a section of the artery; so that nothing can be concluded from it in relation to pure and simple distension. If we should wish to repeat these experiment, which, however, do not appear to lead to any very important result, we might insulate the artery of a limb for a certain extent without entirely separating it, and afterwards employ upon this dis-articulated limb all the necessary efforts. We should avoid in this way the inconvenience of ligatures.

In the arterial curvatures, the convex side is thicker and stronger than the concave one. This arrangement, no doubt accommodated to the greater effort of the blood on that side, is very evident at the arch of the aorta.

Nature of the Middle Coat of the Arteries.

Page 308.—"The action of different reagents upon the arterial texture, proves clearly how much it differs from the muscular. There are then general phenomena common to all the solids; but different peculiar phenomena that are distinctive."

Those who consider the peculiar membrane of the arteries as of a muscular nature, and Haller, Walter and Soemmering are of this number, think so, 1st, because its fibres become soft and greyish in the small arteries, and resemble very much, at least in appearance, those of

the intestine, bladder, &c.; 2d, because the same appearance is found in animals; 3d, because, notwithstanding the dryness, resistance, elasticity and species of brittleness, which distinguish the arterial fibre, there is not more difference between this fibre and the muscular, than is found between the different kinds of muscles; between the great pectoral of birds and the muscles of their claws or stomach, for example; 4th, finally, because the properties which the arteries enjoy during life also approximate their texture to the muscular. It might be added, that it is not very dissimilar in chemical properties; for I am confident it contains a certain quantity of fibrin.

These considerations nevertheless do not seem to me to be sufficient to warrant us in ranking the arterial texture among those which have the muscular fibre essentially for their base. I think rather, considering the elasticity which forms the principal character of it, that this texture belongs, as some anatomists have already thought, to the yellow or elastic fibrous system which will be examined hereafter.

Cellular Membrane and Sheath of the Arteries.

Page 318.—"The arteries have around them two kinds of cellular texture; one, which is very external, loose, fatty, full of serum, with distinct layers, unites them to the neighbouring parts; the other, firm, compact, not fatty, filamentous and not lamellated, forms the first of their coats."

This cellular coat, (*cellulosa propria* of Haller) rejected by Monro, Walter, Scarpa and Mascagni, and which Soemmering united to the peculiar membrane, is

not less distinct from the other coats which it covers, than from the cellular texture which surrounds it.

It is a fibro-cellular membrane, delicate, tolerably dense however, and really forming a constituent part of the arterial tube. In the great arteries it is divided into two laminæ; one external, which approximates more to cellular texture; the other internal, yellowish and tough, which resembles the layers of the middle coat. Its appearance upon the arteries of the middle size is that of the aponeuroses, or still more of the neurilema. Its texture is composed of fibres interlaced and oblique, more separated without than within; these fibres are especially apparent in the distension of the artery, either lengthwise, or across, because they stretch and separate before breaking. Mascagni has given a good plate of them. The small arteries have this coat thicker than the large ones, in proportion to their size; it is on this account that they bear ligatures better, which, as is known, only act upon the cellular coat.

Into this membrane are inserted many soft and extensible filaments, which come from a species of sheath which the artery receives from the surrounding cellular texture. It is the only relation which there is between it and this cellular texture. By means of this arrangement, the artery slides easily in the interior of its cellular canal; the retraction of divided arteries is very much favoured by it.

The cellular sheath of the arteries, the external coat of Soemmering, described by Haller under the name of *tunica cellulosa adscititia*, is in fact nothing but this lamellated cellular texture which joins and embraces them so as to form a real canal around them. Hebenstreit has treated of it in a dissertation which forms a part of the Collection of Dissertations of Haller. This sheath is

attached on one side to the external membrane by the elongations of which we have just spoken, and is continued on the other with the cellular system. It is wanting in some arteries which have serous coverings. Others are destitute of it, from the want of cellular texture in the parts where they are found. Its arrangement varies like that of this texture; in general compact on the extremities, it is very loose in some parts, around the spermatic arteries for example. These differences deserve an examination, because they may explain various morbid phenomena. Thus arterial ruptures are followed in the brain by a general effusion which disorganizes its substance, whilst in the extremities the cellular sheath prevents this accident by circumscribing the progress of the effusion; thus, in this last case, the blood infiltrates to a greater or less extent according to the resistance which the sheath opposes to it, &c.

Nerves of the Arteries.

Page 322.—" There is merely juxta-position" (between the cerebral nerves and the arteries) " as we see it in the extremities, in the intercostal spaces, &c."

The nerves of the arteries are so much the more abundant in proportion as these vessels are of a less caliber; they are more evident upon the branches than the trunks. Those of the arteries of the extremities come in part from the cerebral nerves. Lucae says that he has traced them into the arteries. He has made two classes of them in relation to their course; 1st, some stop in the cellular coat and are lost there, after having run some time in the cellular texture which surrounds it; 2d, others pass through this coat and go to the peculiar membrane, upon

which they are spread into a very delicate network. The first are short and flattened; the second, which are extremely delicate, have a little more consistence, their form is rounder and they run a shorter course. No one reaches the internal membrane; Oudemann says however that he has traced them to the nervous membrane of Haller. Some arteries appear to be destitute of nerves. The pulmonary tree receives fewer of them than the aortic. According to Lucae, the nerves of the arteries are less apparent in old age, particularly the filaments destined for the middle coat.

Irritability of the Arterial Texture.

Page 332.—" The contraction produced by the defect of extension, is that which characterizes the contractility of texture. Irritability or sensible organic contractility, on the contrary, uniformly supposes the application of a stimulus."

Notwithstanding all these considerations, there are physiologists, who allow to the arterial texture the faculty of contracting under the influence of an appropriate stimulus. The reasons which they allege in favour of this opinion are the following. 1st. If the arteries, say they, do not always contract in experiments, they resemble in this respect some textures of whose irritability there is no doubt. The intestines, the bladder and the stomach sometimes give no sign of irritability. 2d. The action of the acids, which Bichat considers as a mere horny hardening, is different during life and after death; in the first case, there is a real contraction; in the second, it is rather a kind of erosion, as Verschuir has seen. 3d. The same author has succeeded in producing a contraction of the artery, by merely irritating it with a scalpel. 4th. In other experi-

ments, the simple contact of the air has produced a sudden and very evident contraction, sufficient to efface almost entirely the cavity of the artery. 5th. This contraction, in all these cases, extended beyond the point touched; it ceased when the stimulus was removed. 6th. The electric spark has also produced contractions according to Bikker and Van-den-Bos. 7th. It is even said that this effect has been obtained by applying stimuli to the nerves of the arteries. Galvanism has been successfully employed in this way by Giulio and Rossi. Home employed alkalies; their contact with the great sympathetic nerve produced violent pulsations in the carotid artery. He was led to this experiment by the local changes which the circulation appeared to experience from severe pains from an ulcer. 8th. Thomson has seen the arterial parietes contracted by the action of ammoniac, so that its cavity seemed to have entirely disappeared. The muriate of soda, on the contrary, almost uniformly dilates them.

Many of these experiments require, no doubt, to be repeated; but we cannot deny, that the contraction of the arteries may be very different during life from what it is after death; for, 1st, an artery, opened between two ligatures, does not continue to empty itself some instants after death, except from an excess of distension, its elasticity does not make it contract. 2d. Arteries, empty at the moment of death, and being still contracted in virtue of this contraction, return to their ordinary dimensions when all vital influence has entirely ceased; their elasticity, which resumes its ascendancy, then supports their parietes separate; this is what is seen especially in death, from hemorrhage; 3d, so in the experiments cited above, the contraction ceased after death, and that which was obtained by putting the elasticity in action by the distension of the parietes was much less marked. No

doubt that the force which thus makes the arteries contract during life does not differ from that which presides over the contraction of the heart, the intestines, &c.; perhaps it is wrong to give it the name of *irritability*; but that of *contractility of texture* is no more suitable to it. Kramp has proposed to make a particular force of it which he calls *the vital force of the arteries.* Parry refers all its effects to tone or insensible organic contractility. Whatever be itsnature, its intensity increases as the arteries become smaller, which Soemmering attributes to the greater quantity of nerves which the small ones receive; the elasticity diminishes in the same proportion.

Action of the Arteries in the Circulation.

Page 345.—" It is not the contraction of the arteries that drives the blood to their extremities.——Each jet of the arterial throw should correspond to each relaxation of the ventricle; the contrary of this is the case as I have just said."

If the arteries do not contract upon the blood, the flow of this fluid would not be continuous but intermittent; whilst it is, as it were, remittent. The jet of an open artery is increased at each contraction of the ventricle, because this contraction increases the velocity of the circulation. It is diminished in the relaxation because there is then only the arterial action which makes the blood flow. The jet should cease entirely at each relaxation of the ventricle, if it was only owing to the contraction of this last. There are then two causes of the motion of the blood. 1st. The arteries, always full, constantly tend, by their elasticity and contractility to react upon this fluid. 2d. The contraction of the heart is added to this by in-

tervals, and gives to the motion a new activity. This last cause is much the most important, especially in the great arteries, but the first is nevertheless real.

Development of the Vascular System.

Page 364.—"The arteries are made to develop themselves, and the heart does not hollow them out, as Haller has said, in the interior of our organs by the force of its impulse. This mechanical manner of considering their formation is evidently contrary to the known laws of the animal economy."

The opinion of Haller is so much the less admissible, as it appears that there are vessels before the heart exists. The development of these vessels, and in general of the whole vascular system, is a point still obscure, but nevertheless curious. Malpighi, Haller, Wolff, and especially in recent times Pander, have traced it in the chick. The first vessels appear in the membrane of the yolk, which represents the umbilical vesicle of man and the superior animals. The vein of this part appears before any of the rest of the vascular system. Its ramifications commence by small insulated cavities, species of vesicles, which are afterwards united by grooves. They are at first mere hollowed passages in the membrane of the yolk, filled with a colourless fluid; the blood afterwards shows its colour in them, the parietes become more distinct and their consistence greater. The small branches, branches and trunk of the vein are developed in the same manner. The vena porta succeeds to that of the vesicle, of which it appears to be but a continuation. Soon after this vein is enlarged at its superior extremity to give origin to the heart. This is then semicircular, and formed entirely by

the left ventricle. The origin of the aorta is afterwards joined to it and then the auricle; both at first quite distinct from the ventricle, gradually approximate it. The space which thus exists for some time between this last and the auricle, is the auricular canal. From the aorta arise successively all the other arteries, beginning with that of the yolk or vesicle, which the vessels of the allantoid membrane soon follow; the development of the arteries is followed by that of the corresponding veins. On the other hand, the liver is developed and the vena porta, united to the umbilicus, is almost exclusively distributed there; the portion of this vein which is extended beyond forms the ductus venosus. The cavities of the heart are completed; a partition divides the auricle into two parts, which still communicate by a large opening; there arises from the superior part of the left ventricle a small tubercle, which by extending towards the apex of the heart, gives origin to the right ventricle. At this period, the base of the heart which the left side alone forms, establishes a communication between the two ventricles, which makes the aorta seem to arise from both of them; the pulmonary artery is yet only indicated by a bifurcation which the aorta exhibits a little above its origin; the two branches which result from this bifurcation unite again after a short course. In the ulterior development of the heart, the place of their separation is found more and more approximating this origin; the two divisions finally detach themselves entirely, and the pulmonary artery becomes a trunk insulated at its origin, and forming as it were a second branch to the aorta. It is itself divided for the lungs of each side, and takes beyond the name of ductus arteriosus.

By admitting that these phenomena, observed in the oviparous animals, take place also in man, as some facts

seem to prove, we see, 1st, that in the beginning the circulating organs are much less numerous than they are to be afterwards. The heart has but one ventricle and one auricle; the vena porta is the only venous trunk, the aorta the only artery, &c. The motion of the blood must then be very simple at this period; this is also what is observed in the chick. The blood, in this last, runs a very simple course at the commencement; it is a single circle, formed by the vein of the yolk, the vena porta, which is a continuation of it, the heart, the aorta and the artery of the yolk. There must be added to it afterwards the umbilical vessels, whose development follows nearly that of the vessels of the vesicle; this gives a little more extent to the circulation without rendering it much more complicated. 2d. In a second period, on the contrary, the circulatory organs are more numerous than after birth. Thus the ductus arteriosus, the ductus venosus, the umbilical arteries and vein and the foramen ovale are afterwards to disappear. There however remain traces of the simplicity of the first period; the auricles, though two in number, communicate together; the course of the blood is much more complex, but the two circulations are still in part confounded. It is not until this second period that the circulation begins to be well understood in man.

MORBID ANATOMY OF THE VASCULAR SYSTEM WITH RED BLOOD.

I. *Alterations in the External Forms.*

The arteries often increase in size, either in their whole extent, or in a single point, or even on one side only of their circumference. The increase of the arteries

in their whole length is a real hypertrophy, which takes place when the organs themselves are the seat of an excess of nutrition, when they experience a very acute and long continued irritation, and under various circumstances pointed out above. After the obliteration of an artery, the collateral branches do not increase in breadth only, but in length also ; thus they describe curves which did not before exist. The partial dilatation constitutes one of the varieties of aneurism, the true aneurism of the ancients. This affection is in fact in the beginning only a simple, circumscribed and sac-like dilatation of the three arterial coats, as is proved by many observations ; the artery is rarely dilated uniformly and in its whole circumference ; when this takes place the disease exhibits differences sufficiently striking to warrant us in distinguishing it, as Scarpa has done, from aneurism; these two kinds of dilatation are sometimes united.

The contraction of the arteries is less common than their dilatation. 1st. It is observed whenever the blood ceases to pass through them, or does it in less quantity, as happens in gangrene, especially in that variety known under the name of *dry gangrene*, in some cases of atrophy, paralysis, &c. 2d. Circumscribed contractions, the cause of which it is very difficult to determine, have been met with, particularly in the great arteries, such as the aorta and the pulmonary artery. In the greatest number of cases the texture of the artery is however sound ; sometimes it has been found thickened. There is often connected with this alteration some organic disease of the heart, or even the rupture of this organ. 3d. Various tumours, situated in the course of the arteries may also, by the pressure they exert, diminish their caliber more or less. Old aneurismal tumours produce this effect upon the arteries in which they are situated, and upon the

branches they are near and which they compress. Under almost all these circumstances, the contraction of the arteries may extend even to their obliteration.

The manner of distribution of the arteries undergoes important changes when a principal trunk is obliterated in a part; there is then formed one or more anastomosing passages which supply the place of the trunk in the whole course of its obliteration, and which carry the blood from the last branch furnished above the obliterated trunk, to the first furnished below it. This is what is seen in ligature of an artery, after wounds of these vessels, aneurisms, &c.

II. *Alterations in the Organization.*

The internal membrane is much more susceptible than the others to inflammation. Sometimes this state is first developed in this membrane, sometimes it is transmitted to it from other organs; it is thus that in acute inflammation of the thorax or abdomen, the internal membrane of the aorta has sometimes been at the same time found greatly inflamed; in the affected parts themselves, the arteries commonly partake of the inflammation of the other textures. The redness which characterizes this arterial phlegmasia is usually accompanied by a thickening of the membrane and an effusion of an albuminous nature, sometimes very copious; the vessels of the peculiar membrane are also frequently more or less engorged.

Inflammation of the arteries is followed by their obliteration, when the two sides of the inflamed internal membrane unite together. This adhesion is owing, like most of the phenomena of this kind, to the circumstance that the effused fluid passes to the solid state and forms a sort of false membrane which afterwards becomes organized.

It is in this way that we can understand how, notwithstanding the destruction of the arteries in ulcers oftentimes very extensive, no hemorrhage takes place; the preceding inflammation has first obliterated the vessels. Pus has never been found in the arteries; perhaps it is carried off by the blood, as fast as it is formed. Ought we to refer to a state of induration or of chronic inflammation many of the organic diseases of the arteries, which are accompanied by a greater thickness and consistence of their texture? This question cannot be resolved. What is certain is, that inflammation, connected either incidentally, or as effect or cause, is often united to similar alterations. Gangrene never succeeds to the inflammation of the internal membrane alone; but the arteries are often comprehended in eschars; it happens then, that the blood is coagulated beyond the dead portion, so that there is no hemorrhage when the eschar separates, unless the vessel be very large.

The cellular texture exterior to the arteries is subject to the same alterations as the rest of the cellular system; inflammation may engorge, thicken and ulcerate it, suppuration may destroy it, &c. The cellular coat, properly so called, is but very rarely inflamed. When it happens and the inflammation is long continued, there sometimes results from it that sort of brittleness which has been treated of in the article on the cellular system; a brittleness which has perhaps, however, been much exaggerated.

That state of the arteries of which Bichat has spoken and which resembles their inflammation, because it consists in a more or less extensive redness of their internal membrane, has been met with in cases in which it could be attributed neither to maceration, exposure to the air, the presence of a coagulum nor to the time that had elapsed since death. (See Hodgson on the diseases of the

arteries.) We know not then if it be not, under some circumstances, a real morbid alteration. According to Franck, this redness was constant and occupied the whole extent of the arterial system in a species which he had occasion to observe.

The solutions of continuity of the arteries differ, according as they penetrate the cavity of the vessel, or affect only a part of its membranes.

The first case, which is the most common, has been very well observed by Dr. Jones upon dogs. I have also made some experiments upon this subject. The following is what takes place when an artery of a living animal is opened.

1st. If it be by a simple puncture, with the point of a needle for example, a small quantity of blood flows, a coagulum is formed in the cellular sheath and stops the hemorrhage. This coagulum afterwards disappears, the edges of the opening inflame, and adhesion takes place. The cicatrix is confounded in time with the arterial texture, and no traces are left of the small wound. The cavity of the artery is preserved.

2d. When the wound is of some extent, the issue is different according to the state of the cellular sheath and the direction and size of the opening. If the sheath has been destroyed, the hemorrhage continues in all cases; and, though suspended for a time by syncope, it only ceases with the life of the animal. When, on the contrary, the sheath remains uninjured, 1st, if the wound be longitudinal, to the jet of blood which escapes, succeeds the formation of a clot which shuts the opening; then this cicatrizes, as in the case of simple puncture; only the cicatrix remains apparent; it is linear, continuous with the texture of the artery, and is seen very well by opening this last and examining its parietes against the light;

2d, if the wound be transverse, but occupying only a quarter of the circumference of the artery, the hemorrhage, though more abundant than in the preceding case, because the retraction of the arterial fibres gives a circular form to the opening, may still stop of itself, and its suspension be followed by the formation of a cicatrix, of which I have preserved examples ; 3d, if the wound embraces half the circumference of the artery, the opening takes an elliptical form, and death necessarily ensues ; 4th, finally, if three quarters of the circumference of the artery have been divided, the separation is very considerable; the opposite ends of the artery, extremely elongated, represent, if we may so say, the extremities of two pens united at their points ; the kind of tongue that unites them is finally broken, and the cure, when it is effected, is made by the obliteration of the vessel.

3d. In complete transverse sections, death does not take place unless there is at the same time denudation of the artery. When the sheath is left, the wound is almost always cured in animals by an obliteration of the artery. The two ends retract into the interior of their cellular canal, which thus extends beyond their extremity. The hemorrhage brings on weakness and syncope; the blood is effused and finally forms a coagulum which, filling the sheath, surrounds the artery and shuts its extremity. When the force of the heart returns, the coagulum resists and the hemorrhage does not again come on. The blood coagulates in the artery as far as the first collateral branches, the parietes of the vessel contract, a cicatrix is formed at each end and obliteration takes place. This obliteration is, according to Jones, the result of a lymphatic effusion which is poured out in the artery near its extremity, between the external and internal coagula. When this takes place, the coagula are absorbed and disappear.

The same things do not always take place in man. In punctures, for example, it is extremely rare that the cure is solid, unless the artery is at the same time obliterated. The hemorrhage in this case left to itself, continues without interruption; the blood, if it does not flow out, is effused into the cellular texture, and produces a *diffused or primary false aneurism.* Suppose that by compression or rest, a coagulum should be formed, and a cicatrix even established, the cure may be only apparent. Though this state may continue for years, the blood will finally remove or break these feeble barriers and a tumour will appear; this will be a *circumscribed or consecutive false aneurism.* Such is at least the result of facts observed up to the present time. It is true that we are almost always ignorant of the direction and extent of the wound; and, as has been seen, the termination is very different in this respect. It is thus extremely probable that a puncture made lengthwise would heal as well in man as it does in animals.

Spontaneons cure is likewise very rare, in man, of wounds which comprehend the whole circumference of the artery; and, unless the caliber be very small, these wounds, left to themselves, are uniformly fatal. It is necessary however to except from them, 1st, certain cases in which, notwithstanding the considerable size of the vessels opened, a coagulum formed during a syncope has been sufficiently powerful, or rather the circulation has been sufficiently feeble, so that the hemorrhage has not reappeared and the adhesive inflammation has had time to take place; examples of this kind are cited by Boerhaave, Garengeot and others. 2d. Wounds from fire-arms and those which result from the action of fire and caustics; here it is the eschars which prevent the hemorrhage, and when they fall off the vessels are often obliterated. 3d.

Lacerated wounds; I have collected a number of observations respecting them made by authors; the most remarkable is the case of Samuel Wood, related in the Philosophical Transactions, and since in various works. In some of these observations, death has been the consequence of a copious hemorrhage; but in the greatest number, as also in the experiments which I have made upon animals, a cure has taken place. Besides the retraction and contraction noticed by Bichat, two additional causes are opposed in this case to the flow of blood, and favour the obliteration of the artery. In fact, at the instant even of the accident, this yields and is elongated before breaking; but the internal membranes, less extensible, are torn at first unequally and in different places, and then are completely separated, whilst the cellular coat continues to stretch, approximating more and more the axis of the vessel, like a tube of melted glass drawn at both ends. When the separation is completed, the artery exhibits then at its extremity a conical elongation, terminated by a narrow opening, and in its interior irregular shreds which obstruct its cavity. This last circumstance appears to be the most important of the three, for, 1st, the retraction is often wanting, the end of the artery is pendent, and yet there is no hemorrhage; 2d, by cutting in an animal the summit of the kind of cone which the artery forms, the flow of blood does not return, unless the section be made above the internal lacerations.

Solutions of continuity, which affect but one part of the arterial membrane, act upon the internal or external coats. Hunter and Home have seen, that if the internal membrane be laid bare in dogs, by cutting the external and middle ones, there results from it an albuminous exudation, by which the thickness of the artery is increased. They have even removed these membranes to

a certain extent, without the internal one being distended by the blood. This must however take place in man in what is called *mixed or internal mixed aneurism, aneurysma herniam arteriæ sistens*, in which it is supposed the sac is formed by the internal membrane dilated. Many authors reject this kind of aneurism, but examples of it have been given.

It has been thought, that the distension of the arteries during life, on violent motions, might produce the rupture of the internal membranes and thus dispose to aneurism. But the arteries are everywhere so arranged that it is impossible that their distension can occasion even a partial rupture, of which it is easy to be convinced on the dead body; this would not happen unless their parietes were the seat of some organic disease. This internal rupture is observed, on the contrary, under the following circumstances. 1st. By pressing with a pincers an artery of an animal, we effect the division of the internal and middle membranes, the external one remaining whole; the small wound, which results from it, cicatrizes, and the artery loses nothing of its strength in this place; its parietes are even rather thicker; when there is a great number of lacerations, the obliteration of the artery is sometimes the consequence. 2d. What in the preceding case, happens to a moderate extent, takes place circularly from a ligature, as has been elsewhere said. There is also this difference, that the edges of the wound being in contact are agglutinated by a mechanism analogous to that of the reunion of wounds by the first intention. The artery is then obliterated; the blood is coagulated above and below the cicatrix, as far as the first collateral branches; the obliteration goes all this extent. If these branches are very near, the coagulum being very weak, the cicatrix is not maintained, and a hemorrhage may take

place when the ligature comes off, and even before, when the membranes begin to be broken. Jones says that it is not necessary for a ligature to remain applied upon an artery in order that obliteration should take place; by placing many ligatures and removing them successively, he has seen this effect produced. Travers assures us that obliteration is certain when the ligature has remained applied for an hour; though the blood often resumes its course at the end of that time, the artery is not the less obliterated, according to the experiments of this author. I have uniformly seen in my experiments the artery remain permeable, when the ligature has been removed even at the end of twenty-four hours; it was not closed definitively until the adhesion was established at the moment the ligature came off, which commonly happened at the end of eight and forty hours. 3d. If an aneurism be of any standing, the internal membranes yield to the distension, as we have seen; they are torn by the mere effort of the blood or by any external violence. The tumour, which is then formed by the cellular coat alone, makes more rapid progress; the blood coagulates in its interior and forms fibrous layers, the density of which increases as they are removed from the axis of the vessel; the sac, freed from these coagula, exhibits on its internal surface an irregular line which indicates the point where the membranes cease; these are sometimes floating, and exhibit a sort of incomplete partition which separates the cavity of the sac from that of the artery; this is the true aneurism, arrived to that degree which some have called *external mixed*. In time, the cellular coat itself is affected, it is destroyed, and the sac is formed only of the cellular texture and the other surrounding parts. 4th. In another species of aneurism, which, at an advanced period, does not differ sensibly from the preceding, and

which has been designated under the same name, but which others call *spontaneous aneurism*, the destruction of the membranes precedes the formation of the tumour. This destruction is here owing to the ulceration or rupture which the internal membrane experiences in organic diseases; the blood is then confined below this membrane and distends the cellular coat. This variety of aneurism is perhaps the most common; but it is not correct to say that all begin in this way. Moreover, the ulceration of the internal membrane is not always followed by aneurism; M. Cruveilhier has found this membrane destroyed as well as the fibrous, and yet there was no dilatation of the cellular coat.

Foreign bodies, in contact with the arterial texture, inflame and often ulcerate it so as to open the cavity of the vessel. If these bodies act by approximating to each other the parietes of the artery, they produce an adhesion of these parietes. When they make a circular constriction, like a ligature, they produce mortification in the narrow portion which they embrace, and are afterwards removed with it; this is what takes place with a ligature at the end of from eight to twenty days.

We know the frequency of arterial ossifications; they exhibit many forms. There are circular ones which invade arteries almost in their whole length; they extend to the peculiar membrane, and are sometimes attended with a contraction and obstruction of the vessel; that species of gangrene which is called *senile* is oftentimes the consequence of it. In other cases, the incrustation is much more limited; there is only on the interior of the artery a great number of small white marks, superficial and but slightly prominent. Between these two extremes are found yellowish plates, semi-transparent and irregular, which appear at first to be situated in the space

between the two membranes, but which the blood afterwards touches immediately, because the internal one is destroyed on their surface.

The cartilaginous transformation has also been observed in the arterial texture. It has its seat in the internal membrane, and is characterized by plates of a white colour, prominent, fibrous and very dense. The cartilaginous state almost uniformly precedes the ossifications of the arteries which take place in adult age, whilst those of old people are owing simply to irregular depositions of calcareous matter.

The arteries are changed into a fibrous or ligamentary texture, whenever their cavity is obliterated naturally or preternaturally. This texture in time becomes more delicate, and disappears itself or is confounded with the cellular texture.

There are some morbid alterations peculiar to the arterial texture; they have hardly any thing in common with those which affect the other textures. 1st. Sometimes in aneurisms the internal membrane is found thickened, softened, and as it were fungous. 2d. Growths similar in form to those which are the product of syphilis have been met with in the aortic valves; Hodgson has even seen them in the femoral artery. 3d. The deposition of a pultaceous substance on or under the internal membrane is a much more frequent alteration. It has been compared to steatoma; but there is a greater analogy between it and the tubercular affection. Sometimes this substance, irregularly disseminated, forms on the interior of the artery small yellowish granulations, covered with an extremely delicate pellicle; sometimes, accumulated between the internal and the fibrous coat, it forms round masses, which obstruct more or less the cavity of the vessel, or even real centres, filled with a purulent,

opake and yellowish fluid. The tumour, in the last case, terminates sometimes by opening into the artery. At others, the substance hardens and assumes all the characters of the osseous productions; it then contains much phosphate of lime. This affection is often connected with the osseous transformation. Both are common in aneurisms especially the first.

The arteries partake of the affections of the organs of which they make a part. Their destruction, in cancerous, tubercular and other affections, produces various hemorrhages; sometimes, however, their obliteration prevents the flow of blood.

III. *Alterations in the Development.*

Without speaking of the numberless varieties of origin, distribution, &c. observed in the arteries, and which, being all different from the natural arrangement, exert however only a very limited influence upon the circulation, it will be sufficient to point out some of those the importance of which is greater in this respect. The heart has been seen wanting with all the superior parts, and consequently also their vessels. In the heart itself, it sometimes happens that there is but one auricle and one ventricle; the pulmonary artery arises then from the aorta. Or it is the partition between the ventricles that is perforated; or it is the foramen ovale which is preserved, or the ductus arteriosus that remains permeable. In one instance the aorta terminated immediately after its ascending portion, and the pulmonary artery continued it below. In another, the trunk of the first was bifurcated so as to embrace the trachea and oesophagus.

Besides the capillaries which are developed under many circumstances, arteries of a certain size are some-

times preternaturally produced, Charles Parry says that he has found, in a sheep in whom he had divided the carotid artery, new arteries which went parallel from one of the two ends to the other, the whole extent of the cicatrix, and thus reestablished the circulation.

ADDITIONS

TO THE

VASCULAR SYSTEM WITH BLACK BLOOD.

Venous Valves.

Page 406.—"We find in the works of Haller very minute descriptions of the general arrangement, form and position of the vascular folds of which we are treating."

The following should be added to what Bichat has said.

1st. These valves are more numerous in the superficial than in the deep-seated veins, in those of the extremities, than in those in the interior of the trunk; the superior extremities have fewer of them than the inferior. In general they are not found in the branches of communication

of the veins, such as the median of the arm. The veins of the heart are entirely destitute of them ; it is usually the same with those of the uterus. The spermatic veins of woman have no valves, those of man have. It is on the inferior part of the extremities that there are the most of them ; the veins of the exterior of the head contain but a small number; there are usually some at the opening of the branches in the trunks.

2d. The loose edge of these valves is thicker than the rest, and forms, like the adherent one, a sort of cushion.

3d. Above the valves, the vein exhibits a dilatation which produces a depression on the interior and a projection on the exterior of the vessel. This arrangement, in some cases, gives rise to knots, which are only seen at the places where the valves are.

4th. Besides the two membranous layers which, it is said, form the valves, though they can in no way be separated, fibres appear to enter into the composition of these folds ; at least, by examining them upon one of their faces, white, interlaced filaments can often be distinguished. Sometimes also the valves are perforated and formed by an areolar texture.

5th. Perrault has established many species of valves according to the form which they affect. The only real difference in this respect is, that in the great veins they are very broad, and the curve which they describe small, whilst in the small ones their want of breadth renders this curve more evident. The valves are also broader at the angles of union of the branches with the trunks. This is independent of the state of contraction or dilatation of the veins, which has an influence upon the size of the valves, as has been seen above.

Contractility of the Veins.

Page 415.—"The question," (viz. whether the veins are irritable,) "is not, then, fully settled, though I incline much more to the belief that there is no venous irritability."

Whatever may be the name under which we would wish to designate the contractile force of the venous texture, we cannot refuse to admit that this texture possesses, during life, a property very different from all those which are found in it after death, and consequently one essentially vital. It is in virtue of this property that a vein opened between two ligatures drives out from a distance the blood which it contains, whilst in the same experiment made upon the dead body, the blood only oozes, the effect alone of the elastic spring of the parietes. The contractility of texture, in the sense which Bichat gives to this word, cannot be the cause of this phenomenon, since it exists after death as well as during life. If we compress in a living animal the principal artery of a limb, taking care to keep the limb in a horizontal position, we shall see the sub-cutaneous veins gradually contract, though the circulation may be suspended in the artery, and empty themselves of all the blood which they contained at the moment of the experiment. In the dead body, the veins do not contract thus upon the blood they contain; their size depends always upon the quantity of this fluid which remains in them at the instant of death. Moreover, it is with this contraction as with that of the arterial texture, it cannot be referred to any of the forces which preside over the other kinds of contraction. The galvanic

stimulus appears to be capable of producing it, though this has been denied.

Verschuir calls this contractile faculty of the venous texture *irritability ;* Whytt gives it the name of *vibratory motion* of the veins ; Kramp designates it simply under that of *vital force* of the veins, and others refer it to tone. I shall not decide which of these denominations is preferable ; I would merely observe, that there is in the venous motions during life something besides the effect of the elasticity of inanimate matter.

Venous Circulation.

Page 420.—"The blood is evidently beyond the influence of the heart when it arrives in the veins."

This opinion is diametrically opposed to that of Harvey and the mechanicians of his time, which some modern physiologists have adopted. They consider the heart as the sole agent of circulation, venous as well as arterial ; Harvey compared it to a suction and forcing pump, which on the one hand attracts the venous blood, and on the other sends out the arterial. There is no doubt exaggeration in this manner of considering it, though it would be wrong wholly to reject the influence of the heart upon the motion of the blood in the veins. The capillary and venous action are the principal causes of this motion ; but the contraction of the ventricles should be enumerated among the secondary causes. One fact will be sufficient to prove this. Open a vein and observe the jet of blood which flows from it ; at the end of some time, this jet will be no longer uniform, it will be evidently raised, and the blood will come out quicker at

each contraction of the ventricles. This influence is then real, though much less evident than in the arteries.

Development of the Venous System.

Page 425.—" The veins have in the foetus an arrangement inverse of that of the arteries; they are in proportion much less developed."

By applying to man the labours of Haller, Pander and others, upon the development of the blood vessels of the chick, it would follow from it that a part of the venous system is earlier developed than the arterial system. The first vessels that are discovered are the small branches of the vein of the yolk, or the umbilico-mesenteric. This vein itself, as well as the vena porta, is distinct when the aorta hardly exists. J. F. Meckel thinks nevertheless that, from the arrangement of the sanguineous system in some monstrous fœtuses, and the manner in which this system is complicated in the scale of beings, it would be possible that the aorta should be formed in man at the same time as the first veins, or even before them. If so, this artery must exist before the heart, and communicate directly with the vena porta before the formation of this viscus. With this exception only in regard to the umbilico-mesenteric vessels, the veins in general are not developed till after the corresponding arteries. As it regards the development of the pulmonary artery, what I have said in the vascular system with red blood may be seen.

MORBID ANATOMY OF THE VASCULAR SYSTEM WITH BLACK BLOOD.

I. *Alteration in the external forms.*

The veins, like the arteries, experience total or partial dilatations; this is what constitutes varices. The frequency of this affection in the inferior extremities is well known; the reason of it has been given above. It is also quite often met with in the veins of the rectum, the bladder and genital organs, and in the sub-cutaneous veins of the anterior parietes of the abdomen. The deep-seated veins are not exempt from it, though they are much more rarely affected than the superficial ones. Morgagni has found the azygos vein considerably dilated; the jugulars and the crural sometimes become varicose. In some cases, the whole venous system exhibits a very evident increase. Puschett, who has recently published in Germany a very extensive treatise on the diseases of the veins, has insisted very much on this general dilatation, which, in his opinion, performs an important part in a great number of diseases. The dilatation may, not as we have seen, be confined to a single vein, but extend to all its divisions. The increase of size takes place then not only in the transverse direction; the veins form curves which are evidently owing to their increase in length. Finally there are dilatations still more limited which affect but a part of the circumference of the vessel.

The state opposite to the preceding, or the diminution of capacity of the venous system, is by no means so common. Yet it is seen under some circumstances, either in the whole system, or only in some veins in particular.

This diminution can extend even to obliteration. There are examples of the spontaneous obliteration of the venous trunks themselves, as of the venæ cavæ, jugulars, &c.

II. *Alterations in the Organization.*

The inflammation of the veins takes place under many circumstances. 1st. It has been seen to extend a greater or less distance after the operation of blood-letting. It is always on the side of the heart that it is propagated in this case, and never on that of the capillary vessels.* Death even may be the consequence of it. 2d. Tying the veins, which has been sometimes done in amputations has been followed by inflammation, which, as in the preceding case, extends towards the heart for a greater or less distance. 3d. Tying the umbilical cord appears to have produced the same effect. Meckel the elder, and Osiander have related examples of it. 4th. Veins affected with varices and tied above the disease have also exhibited this phenomenon. 5th. In very extensive phlegmonous inflammations, in those, for example, which come after parturition, in the abscesses and gangrene which succeed them, the veins are often found more or less inflamed on the exterior as well as the interior. This inflammation sometimes extends far beyond the diseased part.

There is no vein which does not sometimes exhibit traces of inflammation, from some of the causes that we have just pointed out. The disorders produced by this affection are, a redness more or less considerable on the internal membrane, with a thickening of the two other coats; purulent collections of different kinds around the

* This rule however is not without exceptions. Abernethy has seen the vein inflame below, almost to the wrist, after bleeding in the arm, and remain sound above, that is to say, on the side of the heart.

vessel or even in its internal cavity, fibrous concretions which obstruct this cavity more or less, sometimes even the complete obliteration of the vein, in some cases a remarkable hardness, and at other times ulcerations; such are the principal disorders to which this affection gives rise.

It becomes salutary, on the contrary, when, as after venesection, it is limited to the lips of the wound, and does not extend beyond the degree necessary for its adhesion. Every one knows that these punctures heal with the greatest ease; it is also known that at the end of twenty-four hours the means of union is still not very firm, that it can even be broken by a moderate effort, and that it is not till afterwards that there is a real cicatrix. The mechanism of the union is here the same as in wounds of the other textures, whilst as it regards the arteries, this union has hitherto been only observed upon animals. If we may credit Mr. Travers, the internal membrane of the veins does not partake of their adhesive inflammation.

The same author believes, that in the obliteration of the veins which follows their transverse division, it is not the adhesion of the internal membrane, but the thickening of the parietes, which closes the cavity of the vessel. His observations upon this subject should be repeated.

Wounds produced by an external cause resemble spontaneous ruptures. Morgagni cites a case of this kind, in which the azygos vein exhibited an oval opening in a woman who died of phthisis. The blood was effused in the thorax; the vein, though partly flattened, had still the size of the vena cava. Convulsive motions have appeared sometimes to be the cause of these ruptures.

Wounds made in the parietes of the veins may affect at the same time an artery which is united to them; if,

in this case, the external wound cicatrizes, the opening of communication subsisting between the artery and the vein, there will result from it the disease described under the name of *aneurismal varix*, in which the blood, passing from the artery to the vein at each contraction of the ventricle, distends this last and produces in it a pulsatory motion analogous to that of the arteries. Sometimes there is merely a round opening, formed of the corresponding parietes of the two vessels ; sometimes there is a consecutive false aneurism, which is found between the artery and the vein. It is in this last case that the disease deserves the name of *varicose aneurism*. The bend of the elbow is the most frequent seat of this affection, of which various examples are found in authors, particularly in the work of Hodgson on the Diseases of the Arteries.

Bichat has already remarked how rare osseous transformations are in the vascular system with black blood ; it is even one of the characters which he has given to the common membrane which lines the whole interior of this system. Yet this membrane is not entirely exempt from them. Morgagni found in a young girl the sigmoid valves of the pulmonary artery partly cartilaginous and already exhibiting the commencement of ossification. M. Corvisart has many times met with this alteration in these valves, as well as in the tricuspid. The veins themselves are susceptible of ossification in old people, especially on the side where they touch an artery. There is sometimes found in the veins small, hard, round bodies, which might be taken at first sight for osseous productions. Some have even supposed that they are formed at first in the parietes of the veins; others have said that it was in the substance of the valves ; Hodgson thinks that their primitive seat is on the exterior of the vein. These bodies, which I have many times had occasion to examine,

have appeared to me to be real concretions, *phlebolithes*. They are usually found in lateral dilatations in which the blood is stagnant ; there is observed in their structure nothing which resembles the osseous texture ; they seem to be formed on the contrary of layers superadded to each other, and have around them a very evident coagulum. They are found also of different degrees of consistence. The veins which exhibit this alteration the most frequently are those in which the course of the blood is the most exposed to being retarded ; thus it is very common in veins which occupy the interior of the pelvis, the neighbourhood of the arms, &c.

The venous texture has not any morbid affection which is peculiar to it ; it partakes of those of the other organs.

III. *Alterations in the Development.*

Are varieties in the situation, origin and distribution of the veins more frequent than those of the arteries, as Haller thought ? Meckel maintains the contrary, and that the veins seem to have more varieties, only because their number is greater. There is perhaps exaggeration on both sides ; yet it is evident that in the great trunks the arrangement is much more constant in the veins than in the arteries.

There are veins in all parts as there are arteries. The following is a proof of it ; a false membrane, which was found in the tunica arachnoides, and adhered to the serous membrane only by one of its edges, at the superior longitudinal sinus, and was entirely free elsewhere, was injected with mercury, which enabled me to see veins going to this sinus.

ADDITIONS

TO THE

CAPILLARY SYSTEMS.

Continuation of the Arteries with the Veins, the Exhalants, &c.

Page 19, *vol.* 2d.—"It has been asked, if there was any thing intermediate between the arteries and the veins, inspection proves that the capillary system alone is there."

It was formerly thought, in fact even since the beautiful discovery of Harvey of the circulation of the blood, that there was a texture intermediate between the last extremities of the arteries and the first branches of the veins. This opinion was founded on the fact that oftentimes in injections, the substance pushed into the arteries, instead of returning directly by the veins, seems at first to be infiltrated in the surrounding cellular texture. It was afterwards perceived, that this infiltration was accidental, that

certain substances only, a solution of glue for example, were capable of infiltrating, whilst others do not exhibit this phenomenon. The existence of an intermediate texture was then rejected, especially as no one had seen this texture. Finally, Malpighi appears to have been the first who proved by microscopical examination, the direct continuation of the arteries with the veins, so well demonstrated since by the experiments of Spallanzani and especially of Leuwenhock. At the present day any one may see this continuation who will take the trouble ; for this purpose, the transparent parts of animals are chosen, as the mesentery of frogs, the tail and limbs of tadpoles, that of fishes, &c. Injections driven through the arteries not only return by the veins, but the reverse also takes place, if the valves do not prevent it.

The continuation of the arteries in the exhalant vessels cannot exist unless these vessels really exist ; now, we shall see hereafter that this point is still very obscure. The communication with the excretories is not demonstrated as it regards all the glands ; there are some in which injections have not passed from the arteries into those tubes; the microscope has not yet shown us the continuation of these two orders of vessels ; we know not, if in the glands even in which they evidently communicate, there be not an intermediate substance.

The last extremities of the arteries communicate also, according to some, with the lymphatics, at the origin of these last ; this will be examined under the absorbent system.

Erectile Texture.

Page 33.—" The spleen, the corpus cavernosum, instead of presenting, like the serous surfaces, a vascular

net-work in which the blood oscillates in different directions, according to the motion it receives, exhibit only spongy, cancellated textures, whose nature is but little known in which the blood appears often to stagnate, instead of moving," &c.

The arrangement of the capillary system in these spongy textures has been very well described by many modern anatomists. The corpus cavernosum has been the particular subject of their researches. It might be thought at first view, that it is a cellular or spongy texture infiltrated with blood ; when it is cut into, this fluid flows from it and seems to come out of the small open spaces and not immediately from the vessels. It is this which deceived Haller and the anatomists who followed him, and made them believe that the blood was poured out by the arteries in the interstices of the laminæ and fibres of the corpus cavernosum, from which it was taken up by the veins.* But if on the one hand, the arteries are injected, they are seen to terminate by very delicate ramifications which go precisely as in the other parts ; and by injecting the veins, on the other, we easily perceive, 1st, that they are much dilated at their origin ; 2d, that the species of enlargements which they occasion have very numerous anastomoses, like the capillary system of which they make a part. It follows hence that these vessels appear, as it were, filled with openings, which makes them resemble meshes communicating together. The erectile texture of the corpus cavernosum is then formed of small arteries and veins interlaced like

*Such was the opinion of Bichat himself, an opinion by no means admissible, and which is abundantly refuted by what is here said of the structure of the corpora cavernosa.

the capillary net-work; all the difference is that here the venous branches are more developed and dilated in a particular manner. These enlargements are so unlike cells, that they are only continued with the veins, and the internal membrane of these vessels is found in them.

Besides, this manner of describing the erectile texture is not new; Vesalius, Ingrassias and Malpighi had seen imperfectly its true arrangement. John Hunter has said positively that it was formed only of vessels. Duvernoy had the same idea from the dissection of the penis of the elephant. In our time Mess. Cuvier, Ribes and others in France, Mascagni, Paul Farnèse and Moreschi in Italy, and Tieddmann in Germany have perfectly demonstrated this fact, both in man and various other animals.

In erection, the blood is accumulated in this texture as Swammerdam is convinced; but we know not the cause of it. Duvernoy attributed this phenomenon to a contraction of the veins. Others have said that it was owing to the entrance of the blood in greater quantity by the arteries; it remains to be explained by this hypothesis, why this afflux exists. Some have pretended that it was a vital expansion of this texture, and that the accumulation of blood was only secondary.

There are some parts whose structure resembles that of the corpus cavernosum, or which are susceptible of a sort of erection more or less similar to its own. This appears to be the case with the spleen as to structure, and even as to phenomena; in fact, this viscus exhibits a real motion of expansion and contraction, 1st, in experiments; when in a living animal, the course of the blood in the splenic vein is stopped, the spleen swells; it contracts as soon as the circulation is reestablished; 2d, in diseases; the paroxysms of intermittent fever are accompanied with an evident enlargement of this organ, which goes off when

the paroxysm is gone; 3d, it appears that the same thing takes place during digestion. But it is especially to the spongy texture of the urethra, the corpus cavernosum of the clitoris, the nipple and the vascular texture of the nymphæ, that the name of *erectile texture* can be applied. The motions of the iris have been explained by supposing it formed of this texture. The lips exhibit something analogous. Everywhere, moreover, the arrangement of the venous system seems to indicate, to a certain extent, the presence of a sort of erectile texture, as has been remarked by M. Chaussier. Injections show the veins everywhere very evident at their origin, and giving rise to net-works with such fine meshes that they might be taken for the cells of a spongy texture; the fleshy part of the fingers exhibits this arrangement in an evident manner.

Capillary Circulation.

Page 36.—" The whole doctrine of the mechanicians rested, as we know, upon the great extent which they gave to the movements of the heart."

What we have said of the venous circulation applies also to that of the capillaries; the experiment which we have cited proves the influence of the heart upon this last as upon the first. Further, if in this experiment, the artery is compressed, the jet of blood which comes from the vein lessens and becomes less rapid. Then by suspending for a moment the action of the heart in relation to the vein, we subtract one of the causes which determined the blood to flow out. Now, what are these causes? The same, nearly, as those which produce the capillary circulation. Then, there are recognized as causes

of the capillary circulation, 1st, the peculiar action of the capillary net-works; 2d, the action of the heart. We should never lose sight of the fact, that the heart may influence this circulation in its own way.

MORBID ANATOMY OF THE CAPILLARY SYSTEM.

I. *Alterations in the external forms.*

The capillary vessels appear to increase in size under two principal circumstances; 1st, when the course of the blood is found interrupted in an arterial or venous trunk; 2d, when this fluid is accumulated in a part from the irritation which it has experienced.

After the ligature of the artery of a limb, there takes place, as is well known, very important changes in the circulation of this limb. All the blood which passed through the tied artery flows back at first towards the capillary extremities of the collateral branches situated above, and thus arrives, by means of the numerous anastomoses of the capillary system, to the branches situated below the tied point. The circulation is then carried on in a circumscribed space, almost exclusively by the capillary vessels, which are dilated in proportion. Injections made upon the dead body show at this period an innumerable quantity of these vessels, many of which become apparent only because the blood passes through them instead of the serous fluids which they contained. In the living animal, this sudden passage of a great quantity of blood through the capillary system occasions an increase

of temperature and often even a redness of the skin, afterwards one or more of these vessels become considerably larger than the others, which return to their original size; the phenomena pointed out gradually disappear. There usually exists then two or three great collateral branches dilated, which reestablish the circulation in the limb.

The spontaneous obliteration of the arteries is followed, like their ligature, by the reestablishment of the circulation by means of anastomoses. The same phenomena take place in regard to the veins; there is, as for the arteries, an increase of the capillary net-works at a certain period. It is necessary moreover, to distinguish this increase of the capillaries, from that which takes place in the anastomosing branches of a more considerable size, and which have been noticed elsewhere.

II. *Alterations in the Organization.*

The capillaries, unknown in their structure, are also unknown in the alterations of their texture. Contusion seems to weaken their parietes; at least they are often, in this case, enormously distended by the blood; concussion appears to act in the same way. The capillaries are frequently ruptured, hence the various species of ecchymosis, sanguineous infiltration, &c. These vessels, divided in wounds, furnish at first blood, then venous fluids, and then a substance capable of concretion, which becomes the base of the cicatrix.

III. *Alterations in the Development.*

Capillary net-works are produced preternaturally, 1st, in the production of false membranes; 2d, in the formation of cicatrices. Stoll appears to have been the first who remarked that, in some cases, the membraneous lay-

ers which cover the inflamed venous membranes contain very evident vessels and are continued with those of the venous membrane itself. John Hunter and M. Chaussier have since made the same observation. Most authors admit that these vessels are only an elongation of those of the serous membrane. Mr. Home thinks with John Hunter that they are developed in altogether another way; according to him, there is, 1st, a formation of small bladders containing only colourless or even gaseous fluids in the beginning; 2d, union of these bladders and the production of a vascular net-work still destitute of blood; 3d, finally anastomosing between the vessels developed and those of the inflamed membrane, and the entrance of the blood into the first. Such appears to be, in fact, the course of nature. If we fill with mercury, at hazard, a false membrane which does not appear to contain vessels, the metal is distributed regularly through it, and takes the form of ramified striæ, similar to the ramifications in leaves; they are the vessels of the false membrane, which existed before communicating with those of the serous membrane. These vessels exhibit even afterwards a diameter greater than that of the vessels of communication, and a peculiar arrangement different from theirs, as I have convinced myself by injection.

It is no doubt by an analogous mechanism that the vessels of cicatrices are produced. Mr. Home and M. Bauer have made microscopical experiments, which support this idea; I think it so much the more admissible, as it accords perfectly with what we know of the formation of the vessels in the natural development of the textures.

We find in a disease described by Bell under the name of *aneurism by anastomosis*, by Frier and the German authors under that *telangiectasis*, this variety of form of

capillary system which constitutes the erectile texture. There is often a defect of conformation which the infant has at birth ; such are most of those called *nævi materni.* This disease appears usually under the form of a tumour, the extent, size, colour, &c. of which vary. A whole limb has been seen to be the seat of it. The texture which forms these tumours resembles that of the corpus cavernosum ; when injected by the arteries, it is not always filled ; injections succeed much better by the veins. The most ample details, however, on this subject may be found in the work of Hodgson, which has been already cited.

ADDITIONS

TO THE

EXHALANT SYSTEM.

Arrangement of the Exhalant Vessels.

Page 69.—" Let us reject then every opinion that disregards anatomical observation, and let us endeavour by this observation to ascertain what the exhalants are."

It is evident, that if we are confined to strict observation, there are no more reasons in favour of the existence of the exhalant vessels, admitted by Boerhaave and others, than there is for that of the lateral pores imagined by Mascagni. It is very true that there exists white vessels, as Vieussens and Boerhaave, at almost the same time, thought, in this sense that the blood passes colourless through many capillaries, which do not become visible until their enlargement permits the red globules to enter

them. The existence of these vessels is especially well established by an experiment of Bleuland ; this author injected by the arteries of the intestine two substances differently coloured, one of which, the thinnest, went beyond the red vessels, into a net-work formed by vessels of another order, which arise from the arteries and terminate in the veins; the coarser substance, on the contrary, filled the arteries and the veins only as far as their direct communication. Ruysch had admitted for a long time that injections colour parts which are not naturally coloured. It is not correct, as has been pretended, that this difference depends only on the quantity of the blood and not on the nature of this fluid ; for, when examined by a microscope, a single globule appears coloured.

But these white vessels, as injections show, terminate like the red by continuing with the veins ; nothing proves that they go further. What are we taught in this respect by the fact of the exhalations, that of nutrition and that of transudation by the extremities of the arteries in fine injections ? That there are openings at these extremities, by which the exhaled fluids, the materials of nutrition and the matter even of injection escape. But are these openings met with at the point of continuation of the arteries with the veins, or are they the free extremities of an order of vessels which extend beyond ? Here, as may easily be conceived, observation is arrested.

ADDITIONS

TO THE

ABSORBENT SYSTEM.

Origin of the Absorbents.

Page 95.—" It is not until they have run a certain course, that these vessels are cognizable by our senses, and that we can consequently study them in a general manner."

The following are the only anatomical views we have upon the arrangement of the lymphatics at their origin.

1st. Cruikshank says that if we examine a small intestine during the process of digestion, we perceive distinctly on its internal surface, the orifices of these vessels, terminated like a watering-pot and filled with a chylous matter which renders them more visible. Hewson, Bleuland and Hedwig have made observations

analogous to this, which contradict, indeed, those of Rudolphi and Alb : Meckel.

2d. By injecting the surface of the liver, and by afterwards making the mercury pass, by pressing with the finger, into the smallest vessels, we shall soon see it, as Mascagni has remarked, come out of these vessels by small openings and appear on the surface of the serous membrane. These openings, it is true, may be only inorganic pores or even crevices, and not the natural orifices of the absorbent vessels.

3d. We have seen, in the liver and testicle, the mercury driven in at the ductus choledochus and vas deferens, return by the lymphatic vessels, which seem to prove that these last are open on the interior of these ducts. I have myself had occasion to ascertain the correctness of this fact.

4th. As to the continuation of the lymphatics with the extremities of the arteries, admitted by the ancients, the fact is still doubtful. Most authors explain the results of injections, by saying that they do not pass from the arteries or the veins into the absorbent vessels, until after being effused into the surrounding textures. Mascagni admits, moreover, that the communication can be established directly by the orifices of the lymphatic vessels open on the interior of the arteries.

Venous Absorption.—Termination of the Absorbents.

Page 108.—" Here, as in so many other points, physiology has need of great light."—There are " many probabilities against and many in favour of venous absorption."

Before the discovery of the lymphatic vessels, the veins were generally considered as the only agents of absorption. Afterwards Hunter and Cruikshank deprived them of this property, to give it exclusively to the absorbent vessels. At the present day, the idea of the ancients is in part resumed, brought forward with new proofs by Meyer, Messrs. Magendie, Ribes and other modern physiologists. The following is one of the most conclusive facts. Insulate to a certain extent the artery and vein of a limb, taking care to cut all the other living connexions which unite it to the trunk, and then introduce a poisonous substance into the cellular texture, the animal will immediately experience all the symptoms of poisoning. Tiedemann and Gmelin have proved by many experiments that all the substances recognizable by their odour, colour or chemical composition, when taken into the stomach, are found in the blood of the vena porta with their peculiar characters. It must be admitted then, either that the veins have absorbent orifices open upon all the surfaces, or that they communicate soon after their origin with the absorbent vessels. Abernethy has observed something similar to this last arrangement; he has seen the vasa efferentia going off from a lymphatic gland in order to go to a vein, and the injection passing from the first to the second.

Structure of the Lymphatic Glands.

Page 117.—" In the interior of these glands, these branches," (absorbents,) " very tortuous, folded upon themselves in different ways, occupy a great part of the peculiar texture of these organs which many thought in consequence were nothing but an interlacing of the ab-

sorbents ; an idea that is not proved, since this texture is not yet well known."

This idea, viz. that the lymphatic glands are nothing but the interlacing of the absorbents, is that of Mascagni who regards them as entirely formed of vessels. Gordon coincides in this opinion, which appears in fact the most probable, from the considerations we are aboutto offer.

There are, as may be seen, two orders of lymphatic vessels in the glands of this name ; some come to these glands, the others go from them. These are the *vasa afferentia and efferentia ;* they are distinguished by their situation and especially by the direction of their valves ; those of the first have their loose edge nearer than the other to the gland ; it is the reverse in the second. The number of these vessels varies ; they are found from one to thirty on each side. There are, in general, fewer of the *efferentia* than the *afferentia*, sometimes as many, rarely more. In order to see advantageously the arrangement of these vessels in the peculiar substance of the gland, it can be injected on its surface with mercury, or in its interior with a substance capable of becoming solid. 1st. If the surface be injected, either through the vasa afferentia or efferentia, it exhibits on the one part, divisions ramified ad infinitum. and forming, as it has been said, two opposite capillary systems ; and on the other, branches dilated, enlarged and anastomosing a great number of times, and forming, like the preceding, net-works intermediate to the two orders of vessels and belonging to both. 2d. The following arrangement is found in the interior ; the vessels, filled with wax, appear even to communicate in two ways, at first by the capillary extremities similar to those, which, in the sanguineous system, terminate the arteries

and commence the veins, and moreover by enlargements which cannot better be compared than to the analogous enlargements which surmount the veins in the erectile textures. It is in these enlargements that is contained that whitish, thick matter, which Bichat and Haller place in peculiar cells, and which is found more abundant in children.

All the glands of any size exhibit in an evident manner the structure we have just pointed out; it is distinguished even in many of the small ones, though it is less apparent in them. There is but very little cellular texture in these glands, and it is very delicate if we except the fibro-cellular membrane which surrounds them. Their veins are in very considerable number, especially in this membrane. Mascagni, Walter and others have not been able to trace nerves in them.

Properties of the Absorbents.—Sensible Organic Contractility.

Page 120.—" The sensible organic contractility is then at least doubtful in them, if it exists it is very obscure and at most to be compared to that of the dartos muscle."

Schreger has seen the absorbents in many experiments, contract under the influence of irritating agents. Not only the concentrated acids, but also the butter of antimony, alkohol and hot water, which we cannot suspect of acting by the horny hardening, have produced this effect. The action of cold water is often sufficient to obtain the same result. Mechanical irritations have been followed by alternate contractions and dilatations. Under all these circumstances, the contraction is propagated

always beyond the point touched, to a certain extent. These phenomena, which are very striking during life, are also observed after death ; they continue even more than those of muscular irritability. If we add to this that the thoracic duct is often, after death, broad and flattened, though empty, whilst during life it is almost always found contracted and hardly visible, we must admit that the lymphatic vessels have a power of vital contraction different from that which they possess after death. It must be by this power that they contract and empty themselves more or less completely when opened between two ligatures ; and in fact Tiedemann has observed that this phenomenon, very evident during life, in the thoracic duct and some other trunks, which then empty themselves by a real jet, is very slight after death.

MORBID ANATOMY OF THE ABSORBENT SYSTEM.

I. *Alterations in the External Forms.*

The absorbents appear to be able to be dilated preternaturally. Some authors consider as dilatations of this kind the species of hydatids that are observed especially on the plexus choroides, in which they are arranged in a line, united to each other by filaments.

II. *Alterations in the Organization.*

Inflammation of the lymphatic vessels is followed, like that of the veins, by suppuration, albuminous effusion,

obliteration, &c. It has been already discussed as well as that of the glands. The wounds of these parts heal in general quite early ; it is not known if it be with an obliteration of the vessel ; the cellular texture no doubt contributes much to the process of reunion. This process is sometimes very slow in the glands ; thus it is often preferred to remove them in operations, for fear that their swelling would separate the edges of the wound and retard the progress of cicatrization. Ruptures, analogous to those which take place in the veins, have been seen in the absorbents ; Assalini and Th. Bartholin relate examples of them as it respects the thoracic duct.

The lymphatic glands are frequently the seat of the transformation to bone, even at an age not greatly advanced. Their ossification has commonly taken place in one part only of their extent. The frequency of the tubercular disease of these organs is known ; this is not the place to describe this affection.

III. *Alterations in the Development.*

The anatomical varieties are very numerous in the lymphatic as in the sanguineous system, besides those which are purely accidental and which depend on the kind of death, the previous disease, &c. These varieties extend to the principal trunks as well as to the secondary branches, to the glands as well as to the vessels. Thus the thoracic duct is sometimes double, at least in a certain part of its course ; the two branches then often unite again and thus enclose a kind of islands. Nothing is more variable than the terminations of this canal at its superior extremity : it is seen sometimes single, sometimes pouring the lymph by two or even three orifices into the left sub-clavian vein, sometimes instead of open-

ing into this vein, it goes to the jugular, the right subclavian, or sends a branch to the vena azygos. The glands do not vary less in their number and situation.

Inspection has not yet demonstrated lymphatic vessels in the preternatural textures, such as cicatrices ; yet absorption supposes them there, unless we prefer to have recourse to that of the veins.

ADDITIONS

TO THE

OSSEOUS SYSTEM.

Intimate Structure of the Bones.

Page 160.—"Let us consider the compact texture as an assemblage of condensed fibres, not separated by layers, which we can only consider as imaginary."

Much has been written upon the intimate structure of the bones, upon that of the compact texture in particular. Malpighi admits that there are laminæ and fibres in this texture. Gagliardi has described minutely the osseous pins; there seems to be some truth in his opinion, because we distinguish in fact in the bones, fibres which go obliquely through their substance. Albinus, who is followed in this by most modern anatomists, says that there are only fibres in the osseous texture, parallel in the long bones and radiated in the broad ones. Finally, if we may

believe Scarpa, there is nothing but small spaces in the compact substance of the bones as in the spongy substance. Michel Medici has already combatted this idea and thinks with the ancients that it is under the form of laminæ that the osseous texture is arranged.

By confining ourselves to the examination of the facts alleged for and against these different opinions, we see, 1st, that the existence of the fibres is by no means demonstrated by the linear appearance which the osseous particles take at their development; in fact, this arrangement does not continue long; in the broad bones, for example, these pretended fibres, which then extend to the middle of the substance of the bone are afterwards changed to an areolar texture. There are however fibres in the bones, as we see after having deprived them of their calcareous matter. 2d. We may be convinced even that there are laminæ, by taking a long bone softened by an acid and macerating it in water; its compact texture separates at the end of some time into distinct laminæ, united by fibres which pass obliquely from one to the other. 3d. In this experiment, the laminæ often finally resolve into filaments and the whole bone at the same time becomes spongy. From this last fact, and from this, that in many diseases of the bones, the compact substance becomes spongy, as well as from the circumstance, that it evidently takes this appearance when, as Troja has done, a swelling of a long bone is produced by introducing a foreign body into its medullary cavity. Scarpa concludes that the areolar structure alone exists in the bones of which we have spoken. This conclusion is not accurate, since besides the areolæ or small spaces, maceration shows in the bones laminæ and distinct fibres. It is true that, if this maceration be very long continued, it converts the fibres themselves into a substance, as it were spongy, into a kind of mucus.

It would seem then that it is by having had regard only to a small number of facts at a time, that each author has explained, in his own way, the arrangement of the osseous particles, and that we ought to admit in the bones laminæ, fibres, and areolæ or small spaces; some are more evident in the spongy texture, others are more developed in the compact substance.

Arrangement of the Pores of the Compact Texture of the Bones.

Page 160.—"Such is the intimate juxta-position of the fibres of the compact texture, that they leave between them only pores hardly sensible to the naked eye, but which become so however with a glass and which the medullary juice and vessels fill."

These pores are in many places real tubes which contain marrow and blood-vessels. Havers, Monro, and, latterly, Howship have described them. They are $\frac{1}{400}$ of an inch diameter. Most of them are parallel and united by others whose direction is transverse or oblique to the first.

Composition of the Osseous Texture.

Page 167.—"Upon this point," (the composition of the bones,) "I refer to chemical books, especially to the great work of Fourcroy."

The human bones contain, according to M. Berzelius, in 100 parts, 1st, 32,17 of gelatine and 1,13 of blood vessels; 2d, 51,04 of phosphate of lime, 11,30 of carbonate of lime and 2,00 of the fluate of lime; 3d, 1,16 of the

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phosphate of magnesia; 4th, 1,20 of soda, hydro-chlorate of soda and of water.

This analysis, hitherto the most complete, does not agree entirely with those of other chemists. Thus, Fourcroy and Vauquelin have recognized the existence of the oxyds of iron, and magnesia silex and alumina in the bones; on the contrary, they have not found fluoric acid in them. Besides, the chemical composition of the bones exhibits many differences not only according to age, sex and individuals, but even in the different parts of the body. The analysis of M. Berzelius was made upon the femur of an adult. But the teeth evidently contain much more earthy substance; it even appears that it is so with the petrous portion of the temporal bone. Various other examples of this kind are recorded in the Anatomy of Monro, from the new researches of J. Davy.

In an anatomical point of view, the bones are composed essentially of a peculiar fibrous texture in the areolæ or small spaces of which the calcareous substance is found deposited. It is this texture that is obtained by treating a bone with acids. The residuum of this operation is not a cartilage, it has neither its whiteness, consistence nor composition; flexible like the ligaments, it very much resembles the fibrous organs, from which it differs only in this, that ebullition transforms it more easily to gelatine, and that maceration softens it quicker. This texture contains all the organic elements of the bone. We cannot then consider it merely as gelatine, and say that the bones are only a mixture of this substance and calcareous matter, as some authors have done. This expression is so much the less proper, as the gelatine does not exist, as far as it appears, completely formed in the bones, no more than in the other animal matters, since it always

requires the aid of ebullition to obtain it. Besides, if we boil glue and calcareous matter, there results from it only an unorganized compound, brittle and very different from the osseous texture.

Veins of the Diplöe.

Page 168.—"The accompanying veins of these arteries" (the arteries of the spongy texture) "can hardly be seen."

Very large, but insulated veins exist in some parts of the texture of the cells. They are contained in peculiar venous canals, which Hippocrates pointed out, and which have since been very well described and injected by M. Fleury. These veins form very numerous anastomoses; they are especially apparent in the diploe of the bones of the cranium but they are also found in the ossa ilii, in the substance of the vertebræ and in the extremities of the long bones. Their size is greater in old people.

Development of the Osseous System.

Page 206.—"I would observe that the arteries, which have so great a tendency to ossification, are not so evidently gelatinous as many other substances which ossify much less easily, as the tendons for example."

Duhamel, J. Hunter, Nesbith, Reichel, Stenff and many others have made known many interesting facts which deserve to be recorded here. The natural development of the bones only will be treated of, the preternatural belongs to morbid anatomy.

The cartilaginous state is not always distinct. The bones of the cranium really have no pre-existing cartilages. We shall see that it is the same with regard to the middle of the long bones.

The osseous state commences about the time stated by Bichat. Stenff has found the first rudiments of it at forty days. I have seen some osseous points in embryos of thirty days or near that period. The clavicle and the jaws appear first; then successively and with some days interval, the humerus and the femur, the bones of the leg and those of the fore-arm, the ribs, and vertebræ, the bones of the cranium, &c. The sternum, the ossa wormiana, the patella, and the bones of the carpus are the last that are ossified. This order is not however confined to any rule; thus all those, which it has been attempted to establish, are for the most part false in their application. The only one which has any real foundation is, that the long bones generally precede the broad ones in their development, though there are exceptions. But as to the influence which some authors have given in this respect to the proximity to the heart and to that of the nervous system; as to what others say of the more or less early development of the bones according to the degree of importance of their functions in man, or, as some think, according to their more or less intimate connexion with the phenomena of life in the different classes of animals, nothing of all this is founded upon observation.

Great changes take place in a cartilage which is converted into bone. Vascular tubes, which could not before be discovered in them, are developed. Colourless in the beginning, and irregularly arranged, they are afterwards ramified like the arteries, and traversed with blood. The colour of this fluid manifests itself by degrees; these tubes however do not appear to contain it directly; the

vessels of the cartilage injected seem rather merely to line their parietes ; this kind of vascular membrane, which covers them, has even been considered as furnished to secrete the osseous substance. These tubes are very well seen in the short bones and the extremities of the long ones. The osseous points, the development of which follows closely that of the vessels, is at first merely an union of filaments of extreme delicacy, which it is easy to insulate by burning the cartilage ; a kind of flake formed of the calcareous matter is then obtained. As the ossification advances the vascular canals are effaced ; no more traces of them are found as soon as the epiphyses become solid.

The action of the blood vessels is then increased in the ossification of the cartilages. But do these last experience any other change in their texture than that which results from the deposition of an earthy substance ? or is the organic matter renewed, as some authors have thought ? It is necessary in fact that the cartilage should undergo a very great change, if it does not entirely disappear, in order to become bone ; for it contains, as we shall see hereafter, scarcely any thing but water, cellular texture and albumen, whilst the bones are formed of a fibrous texture united to a saline substance. There is then a very great difference between the composition of the first and that of the second, and it cannot be said that the bones are merely cartilages, with the addition of calcareous matter. Whatever may be the materials of ossification, it is the arteries which bring them and pour them out, either by exhalant extremities, as Bichat thinks, or by lateral pores, which is the opinion of Walter. These vessels do not perform the part, which Nesbith, Reichel and W. Hunter attributed to them, of giving place by their ossification to that of the cartilage. The regular

lines which the bones exhibit in their development and which have imposed upon these anatomists, by no means follow the course of the blood vessels. We shall be still less tempted to admit the hypothesis of Mascagni, who, regarding the cartilages as entirely formed of lymphatic vessels, supposes that in their ossification these vessels are merely filled with calcareous matter.

In the long bones, the first osseous point appears from the fortieth to the sixtieth day, a little sooner in the clavicle. The small cylinder which it forms is then the only solid part of the bone; all the rest is still mucous. It is not until from the sixtieth to the seventieth day that the cartilages of the extremities appear; when these last are ossified, which does not take place till much later, there is formed between them and the body of the bone vascular canals similar to those which occupy their interior. There is then this remarkable difference between the bodies and extremities of the long bones, that the cartilage cannot be distinguished in the first as in the second. In the middle, the osseous texture seems to be formed entirely of one piece on the internal face of the periosteum; this texture is evidently cartilaginous in the beginning at each extremity.

The ossification of the broad bones of the cranium begins at about two months and a half. The osseous points are at first scattered in the thickened mucous substance which represents the bone at this period. They afterwards unite and take the form of irregular net-works; it is not till later that they have that of osseous rays, still covered with mucous substances on their two surfaces. These rays disappear when the two compact laminæ are formed; they are changed into the texture of the cells.

The increase in length of the long bones takes place near their extremities; the middle has no part in it. An

experiment, for which we are indebted to John Hunter, proves this ; if the body of one of these bones is perforated in two different places, and the animal is killed some time after, the two openings are still at the same distance from each other, though the bone may have increased in length. They would, on the contrary, be further apart, if the growth took place in the whole extent of the bone. Another fact confirms this. In the experiments with madder, the colour appears in young animals only in the space which separates each extremity from the body of the bone ; the rest is only red at the surface, unless the animal has been fed for a long time with this substance. Whilst a cartilaginous layer exists between the body and the extremity, we consider that the growth must take place at the expense of this cartilage. But when it is once invaded, it must be admitted that there is a deposition of osseous substance in this place, preceded at most by the mucous state. The growth in length continues until the epiphyses are united to the body of the bone, which takes place at about the age of twenty-one. A delicate lamina of compact substance is at first interposed between the body and the extremity ; this afterwards disappears and the continuity becomes perfect.

The three species of bones grow in thickness much beyond the term of their growth in length, as has been already said. New layers are incessantly added to their surface, as is shown by the colour of this surface from the continued use of madder. If the use of this substance has been alternately discontinued and resumed, the external layers of the bone are alternately red and white ; whence it must be concluded that they were formed during the continuance of the experiment. The osseous substance is produced there as in the preceding case without pre-existing cartilage, and perhaps by passing through the mucous

state ; but there is no interstitial deposition, as in common nutrition ; it is rather a sort of juxta-position. This does not prevent the nutrition from taking place in the bones the same way as in the other parts. The use of madder for a considerable time, so as to obtain the effect noticed by Bichat, is a proof of it. There are also cases of preternatural growth, both in length and thickness, which appears to arise from a real excess of nutrition.

At the same time the bones increase on the exterior, their internal cavities enlarge ; which occasions the parietes of the medullary canal of the long bones to remain in nearly the same proportion of thickness, as long as their growth without and their diminution within counterbalance each other. The bone gains on one side what it loses on the other. It is not the same in old age. The growth in thickness does not continue, and the internal dilatation does ; there results from it an extreme delicacy of the parietes of the medullary cavity. This cause is one of those which render the bones of old people so brittle.

Some important changes take place in the osseous system in old age. The broad bones diminish in general in thickness. Their texture of the cells disappears and the laminæ of compact substance, which it kept separate, come together ; this is what is often seen in the parietal prominences, in which it is so much the more striking as these prominences are replaced by a depression. Sometimes the broad bones seem to have increased in size, because their texture is, if we may so say, rarefied ; delicate laminæ which pervade it, give it this appearance. In the short bones, the external compact substance diminishes ; the areolæ of the spongy texture are on the contrary more evident. The long bones, besides what they

lose of their thickness, seem also to experience a real shortening. Finally, the change of composition which takes place in the osseous texture takes from it much of its elasticity. The bones of young subjects are flexible to a certain extent; we see that at this age the long bones bend and the broad ones yield under certain circumstances. The same causes will produce a fracture in an adult, and for a stronger reason in an old person.

Second Dentition considered at the period of Cutting.

Page 219.—"The second molar" (of the first dentition) "remains, as we have just said; it is the first of the great ones" (of the second dentition.)

This is an evident contradiction, and must have escaped Bichat from want of attention, or else it is a typographical error. It is said above that the first dentition is composed of twenty-four teeth, of which four molars in each jaw are cut towards the end of the second year, and two other molars towards the age of four years. It is then these last, or the third of the first dentition, which form in the second the first large ones. The new small molars take the place then of two teeth of the same nature, and not one alone. All the difference is, that these new small molars are much less strong than the teeth to which they succeed; these resemble very much the great molars.

MORBID ANATOMY OF THE OSSEOUS SYSTEM.

1. *Alterations in the External Forms.*

Swelling of the bones is of many species. 1st. There are tumours which seem to be deposited, as it were, on the surface of the bone, so that this is perfectly sound below ; such are most exostoses. This affection appears to depend, in many cases, upon an inflammation of the periosteum, in consequence of which this membrane is detached, and secretes from its internal face a matter which hardens and becomes confounded with the texture of the bone ; a sort of periostosis precedes the formation of the osseous tumour. This is more or less voluminous according to the extent of the inflammation. If the inflammation be circumscribed, there results from it what are called *nodes.* These tumous are at first very distinct from the bone ; afterwards maceration still detaches them from it, and they are seen holding to the periosteum ; it is not until a long time that they appear to be continued with the osseous texture ; it may then be seen by the microscope that their vessels have not the same arrangement as those of the rest of the bone, and do not appear to be an elongation of them. When on the contrary the periosteum is inflamed for a great extent, enormous laminæ are produced and give rise to the exostosis called *lamellated ;* the bone is entire beneath these laminæ as in the other cases. 2d. Some exostoses have their seat in the bone itself, and are produced by a development or separation of its most superficial laminæ. 3d. The whole bone is stretched, becomes thinner and is considerably dilated in spina ventosa. 4th. A real

excess of nutrition is the cause of the increase of size, when there is joined with it an increased density, or when the density remains the same. This is what is seen in exostoses that resemble ivory, and in some cases in which the whole of the bone appears to have increased at once in thickness and consistence. To the same cause may be referred the increase in length which the bones of scrophulous individuals sometimes undergo, that in breadth which the bones of the cranium, of the maxillary sinus exhibit, in affections of these cavities. This preternatural growth, which takes place in one or many bones whilst the others do not partake of it, is not effected by a mechanism analogous to that of the natural development. There is here an interstitial deposition, and not a formation of successive layers.

The increase in substance may be confined to the increase of the density of the osseous texture. Enostosis or internal ossification, in which the cavities of the bones are effaced, is an example of this. The bones of rickety subjects exhibit an analogous phenomenon, in the compactness which their curvatures acquire on the concave side.

A state opposite to the preceding is the species of atrophy which this texture experiences when absorption begins to destroy it, either on the interior, as takes place in old age, or on the exterior, as has been sometimes observed. According to Howship, to whom we are indebted for new researches upon the alterations of the bony texture, the brittleness of the bones depends in some cases, in syphilis, for example, upon an alteration of this kind, a sort of internal absorption which transforms the compact substance into a spongy texture. This author distinguishes the brittleness which arises from this cause from that which comes on, for example, from

scurvy and scrophula. This last is generally attributed to a defect in the proportion of the constituent elements of the osseous texture; but there appears to be besides an alteration of the animal matter.

The mollities ossium resembles brittleness very much; both of them are often met with in the same bone. Mollities is of two kinds. One affects adults; the bones which are the seat of it become soft and flexible, and are bent by the effort of the muscles alone; in the dead body, the scalpel cuts them easily. Desiccation and stewing show that there is an evident predominance of gelatinous substance in these bones, which is also indicated by their colour and appearance. The other species of mollities, peculiar to children, differs from the preceding in many respects.

The bones, compressed by neighbouring tumours, experience various changes in their shape. These tumours often also destroy them in part, perforate them and wear them out to a greater or less extent. This happens especially to those which are agitated by a pulsatory motion, such as from aneurisms.

The connexions of the bones, or the articulations are the seat of various affections which change more or less the relations of the articular surfaces. The consolidation of the immoveable articulations, luxations and anchylosis of the moveable articulations, exhibit examples of them. Preternatural connexions sometimes take place between the bones, as is seen in false articulations. Among these last, some succeed to luxations, and deserve the name of *supplementary articulations;* others, which are in consequence of fractures, which are formed by a single bone divided into two fragments, are *supernumerary articulations.* 1st. When a luxated bone has not been reduced, it may form for itself a new cavity in the place

it occupies. This cavity gradually acquires a suitable depth ; an edge, at first cartilaginous, and afterwards osseous, is formed on its circumference ; the cellular texture thickened around the surface represents a sort of fibrous capsule,* which contains a viscid fluid a little less unctuous than the synovia. A fibro-cartilaginous periosteum covers the new articular cavity. The old one is altered and generally diminishes in extent. 2d. When the two ends of a fractured bone do not unite, either on account of their mobility, or from any other cause, the new relations which they contract resemble in some measure an articulation, though in a less degree than in the preceding case. Most often in fact, the fragments hold together only by a kind of fibrous intermediate lines. In some cases nevertheless their extremities become round and are encrusted with cartilage, and a fibrous capsule surrounds them. In some fractures of the neck of the femur, the inferior extremity has been seen to form a cavity in the superior; this case might be confounded with the separation of the epiphysis.

II. *Alterations in the Organization.*

But little is known of the effects of inflammation upon the osseous texture. It is certain however that the bones suppurate. They exhibit this phenomenon in caries, a disease whose nature is still unknown, and which appears to be in many cases a real necrosis. In what is called *white swelling*, and which certainly comprehends very different affections, something analogous is often seen in the articular extremities. They are then the original

* Bichat speaks of this capsule under the synovial system, to which it seemed to him to belong rather than to the fibrous system. The fact is it has not always the same appearance in different cases.

centre of the disease. The spongy substance is at first softened, penetrated with vessels and then infiltrated with a reddish serum. The bone afterwards suppurates, and fistulas are formed in its interior, which are directed sometimes towards the external compact substance, and sometimes towards the articular cartilage. In this last case, the cartilage, till then sound, is detached from the bone, becomes thinner and is perforated with holes; and what proves that the disease begins at the bone is, that the opening remains smaller on the free surface of the cartilage than on its adherent side, as has been well seen by Messrs. Palletta and Brodie, who have described this affection, and as I have myself ascertained.

Gangrene of the bones is necrosis. It is followed by the same phenomena as that of the soft parts, only it requires a longer time for the inflammation, suppuration and separation of the dead parts, which here take the name of *sequestra*. But this necrosis varies moreover from its extent, as well as from its seat. It is usually the result of the destruction of the nourishing vessels of the bone, from the detachment of the periosteum or the destruction of the medullary membrane. When it is the medullary membrane which is injured, the necrosis only affects the internal laminæ of the bone; the sequestrum is then contained in the medullary canal, and has the thickness of the bone to go through before it can be thrown off. But in other cases, the periosteum is inflamed at the same time and is separated from the bone; this is then affected with necrosis in its whole thickness, and there take place all the phenomena described in the article upon the medullary system; the periosteum secretes a new bone, which surrounds the dead one. Here this membrane must have remained uninjured, for if it were destroyed there would be no regeneration.

It is without cause that Scarpa and others have denied this regeneration, and have pretended that what has been regarded as a new bone was always a part of the old one, dilated by inflammation and which the necrosis had spared. The sequestrum has precisely the form of the old bone; all the prominences and the most superficial depressions are found in it; the numerous specimens of this kind that are in existence leave no doubt upon the subject. What has perhaps imposed upon the authors we have just mentioned is, that the dead bone is worn on its surface and covered with inequalities. The new bone has an irregular form, and resembles rather an exostosis or a kind of vegetation, than a bone which existed originally. Finally, in the broad bones, such as the scapula, this is still more striking; there exists then two bones of new formation, one external, the other internal, and the old bone which is dead, is contained in the space between the two.

The separation of the periosteum and the denudation of the bones, which is the result of it, are not always followed by necrosis, when they take place only to a certain extent. If the bone has not been much contused, if the subject be young and the integuments be reapplied, an immediate reunion is obtained by the effusion of a coagulable matter. This matter exhibits at a certain period, irregular osseous points, which have given origin to the belief in insensible exfoliation; these points are afterwards effaced.

Solutions of continuity of the bones, or fractures differ according as there is at the same time a wound in the soft parts, or these parts still cover the place of fracture. The phenomena are entirely different in the two cases. It is only to fractures with denudation that must be applied all that has been already said upon the formation of callus.

In these only arise the fleshy granulations which afterwards form the basis of the cicatrix, whether there has been exfoliation by denudation or not. In the others, there are the three periods that have been pointed out; 1st, a period of exudation; 2d, a period of tumefaction; 3d, a period of reunion.

First period. The osseous texture cannot be divided without the flow of blood from the open vessels; thus there is effused at first a certain quantity of this fluid between the two fragments; this quantity is usually inconsiderable, and the blood stops of itself at the end of a short time. Another fluid succeeds it; this is of a seròus nature and of a slightly viscid consistence. The effused blood gradually loses its red colour. Reunion is effected in the periosteum, the medullary membrane and in all the other soft parts which have suffered by the effect of the fracture alone.

Second Period. These reunited soft parts, the periosteum in particular, inflame, swell and separate from the bone; hence a tumour which is visible externally. This tumour is in great measure formed by a coagulable substance effused under the periosteum and between its internal laminæ. Osseous points are formed in this substance and finally take entire possession of it; the cartilaginous state is hardly sensible, and exists at the most but in some points. For the want of periosteum, the cellular texture becomes the seat of this ossification, as has been seen by Macdonald. The medullary membrane is also ossified.

Third Period. Hitherto scarcely any thing has been done in the bone itself; only the two ends are found joined externally by a sort of clasp, and internally by a plug which shuts up the medullary canal. But this union has only a slight degree of solidity; and if the bone be

again subjected even to inconsiderable efforts, the callus will yield or bend, and even break. The process of reunion is carried on in the fragments themselves ; the intermediate substance which filled the space between them, hitherto fluid becomes gradually more consistent, and is penetrated with vessels which are continued with those of the periosteum and even of the bone. This substance is not long in being ossified ; it is not known precisely in what manner, though vessels have been clearly seen to be developed in it. At the same time that these phenomena take place, the external swelling flattens down. Afterwards, the ossification of the periosteum disappears, the medullary canal is reproduced, and things are restored to the state in which they were before the fracture.

There is then in the reunion of fractures, as in wounds of the soft parts, a vascular cicatrix, formed nearly by the same mechanism. The whole difference consists in the changes which the surrounding parts undergo, and which give place to the development of a provisional bone, before the final callus is formed. Strike out the second period, and the mode of reunion of fractured bones will not differ sensibly from that of the soft parts.

It is thus seen what should be thought of the opinions so various, which authors have had upon the formation of callus. Most are exclusive from having observed the callus in one period of its development only. It is thus that Duhamel, and after him Fougeroux and Pelletan, have seen perfectly that the periosteum is ossified ; but they attributed to it too much in supposing that it was this which constituted the callus. Now this will not appear astonishing, when it is known, that Duhamel did not pursue his experiments upon the callus, otherwise so praiseworthy, beyond thirty or forty days. So Boer-

haave, Haller and Dethleef found between the fragments a lymphatic matter and were satisfied with this observation. Almost in our days, Hunter, Macdonald and Howship have said that it is the effused blood, the colouring matter of which is absorbed, which is afterwards organized to give birth to the callus. Others from the example of Bordenave, have been deceived by what takes place when the fracture is in contact with the air, and have thought that it was the same when the fragments were not exposed ; Bichat himself did not avoid this errour. Some, such as Troja and Camper, have approached nearer the truth, by adopting a mixed opinion. But it is especially to modern anatomists that we are indebted for the knowledge of the facts which we have stated. M. Dupuytren was one of the first who observed these facts. We are indebted to Messrs. Breschet and Villermé for a very extensive work upon this subject.

There are fractures in which no bony callus is formed, but only a fibrous cicatrix which unites the two fragments loosely. It is what is seen especially in those bones which, like the patella, olecranon process and neck of the femur, are very difficult to be kept perfectly fixed. The motions of the fragments and their separation are in fact the sole causes of this phenomenon, which was formerly considered as constant in these bones and dependant on their structure, and which it has been attempted to explain by a pretended dilution of the osseous juice, by the absence of periosteum, &c. The same result is obtained, when in a living animal, a portion of a long bone is cut out ; if the distance between the two ends be too great for their extremities to unite by becoming thinner and extending towards each other, the callus is in part fibrous or fibro-cartilaginous. The opening made by a trephine exhibits also this peculiarity ; when it is very broad the

cicatrix is completed by a fibrous portion. On the contrary, the reunion is immediate, even in bones which were not thought capable of it, when the approximation of the fragments has been exact for a proper time. I have seen patellas thus united ; dried and soaked in spirits of turpentine for the purpose of rendering the cicatrix transparent, as it would have done if it were fibrous, they proved to be osseous in every part. These cases are in truth very rare, because the separation is almost inevitable, as it may come on not only at the instant of the fracture, but as long as the intermediate substance has any extensibility, the callus itself may sometimes yield, and it requires at least two or three months for the callus to acquire complete solidity, instead of from fifty to sixty days as is commonly thought. This termination of the fractures is precisely analogous to what takes place in the long bones, when their fragments are continually moved. There results from it a kind of false articulation.

The bones are rarely affected with organic diseases ; this point of their history has been hitherto neglected. Yet the cancer of the bones has been described under the name of *osteo-sarcoma ;* but much remains to be done to classify all that has been designated under this name. Sometimes a tubercular affection is met with in the bones. They are also the seat of a kind of fleshy tumour, which interrupts entirely their continuity, and the texture of which is very like that of the cerebriform tumours, except that it contains more blood-vessels. I have many times seen these tumours in the clavicle.

III. *Alterations in the Development.*

The osseous system is subject to frequent defects of conformation ; they are observed especially in the bones of the cranium and in the sternum.

The osseous substance has a tendency to be produced under many circumstances. There is scarcely any part which is not ossified by the progress of age. The cartilages are in the first rank ; then come the fibro-cartilages and the fibrous textures as it respects the frequency of this ossification. The cellular texture is the most rarely the seat of it. As to the arteries, there is in many cases a sort of incrustation, rather than a real osseous transformation. The venous, muscular and nervous systems exhibit more rarely examples of it. The preternatural productions are not exempt from this transformation ; cysts wholly osseous are often found. The cartilaginous state does not seem always to precede these ossifications.

ADDITIONS

TO THE

MEDULLARY SYSTEM.

Organization of the Medullary Membrane.

Page 231.—" To be convinced of its existence," (the medullary membrane,) " expose the cylinder that it forms to the intense action of heat; it contracts, has the horny hardening immediately like all the solids, and thus becomes more apparent."

This experiment is made by sawing a long bone, and then plunging it into boiling water; the membrane separates from the bone and adheres to the fat, which enables it to be better seen. The diluted mineral acids may also be used, which produce the same effect.

This membrane when entirely detached from the bone, resembles in some measure a cobweb; it is pierced with

a multitude of holes. The basis of it is the cellular texture and vessels. The first is in small quantity and has no other use than to support the vascular ramifications. Among these last, some which are very well described by Duverney, go outwards to the osseous texture; the others go inwards, towards the elongations of this texture and of the membrane itself. The principal artery of the medullary canal is surrounded by absorbent vessels at its entrance into this canal. An evident nervous plexus is also observed about it, in the bones which are the nearest the trunk.

Moreover, adipose vesicles of the same kind as those of the cellular texture, though they may be a little less distinct, contain the medulla and occupy the interior of the medullary membrane, lodged in the cellular interstices which this last contains ; we know not if they are also found in the spongy texture of the extremities. Authors have for a long time noticed that the medulla is formed of small grains united into a cluster, as is seen especially when it is recent and has not yet lost the consistence which is peculiar to it. But it was believed that these vesicles communicate with each other, as it was then thought of the adipose texture. G. Hunter, Mascagni and many others have seen that they are shut. The description which they have given of them, both from direct inspection and analogy, shows in them an arrangement similar to that of the adipose texture. We shall not advert again to this arrangement.

Sensibility of the Medullary Membrane.

Page 231.—" The most acute pains are the result of the action of the saw upon it" (the medullary membrane) " in amputation."

This phenomenon is not constant; there is often no pain in this case; but we must not conclude from it, as it has been done, that the sensibility of the medullary membrane does not exist. In amputations made upon man, the pain caused by the division of the soft parts, and especially of the skin, is so intense, that this less severe one produced by the division of the medullary membrane, which almost immediately succeeds it, is hardly felt. But if, in a living animal, the operation is suspended after the division of the soft parts, and resumed when the first impression is in part dissipated, the sensation is acutely perceived, and the animal utters distressing cries. The sensibility of the marrow, already recognized by Duverney and since denied, is then real.

Development.

Page 234.—“ This absence of the medullary fat in the fœtus, essentially distinguishes the marrow from the ordinary fat, which, at this age, is already very abundant.”

The fat of the bones, in being wanting in the fœtus, resembles in this respect that of the deep parts in general, which are then almost entirely destitute of it. Moreover, there is not only no marrow at this age, but there is no medullary membrane. Bichat did not wish to consider this membrane as a new organ; but it is evident that nothing indicates its presence before ossification. Afterwards, when the medullary canal begins to be formed, the nourishing artery fills it entirely; it is not till an after period that this artery is thrown out upon the parietes of the cavity and that the medullary membrane exists.

The marrow becomes very abundant in old age, owing to the enlargement of the medullary cavity.

Functions.

Page 236.—" Who does not know, that in diseases of the articulations in which the synovia is altered and vitiated, the marrow of the corresponding bones is almost always in a perfectly sound state."

To the reasons for not admitting the production of the synovia by the transudation of the marrow through the articular extremities, may be added those which Soemmering has given, viz. that the marrow is the most abundant precisely in the place the most remote from the extremities, and that children, who have no marrow, and whose extremities are all cartilaginous, have not less of synovia in their articulations. This last fluid is met with besides in many places where the other evidently cannot penetrate, as around the tendons, in the bursæ mucosæ, either natural or preternatural ; finally, there is a total difference of properties and composition between it and the medullary fat.

Various uses, not less hypothetical, have also been attributed to the marrow. It has been thought to be well adapted to give flexibility and tenacity to the bones ; this was the opinion of Duverney ; but if it be recollected that the bones of young subjects are the least susceptible of breaking, and that those of old people, which contain so much marrow, are on the contrary the least resisting, much attention will not be paid to this opinion, which rests only on a single fact ; it is this, that the bones, reduced by combustion to their calcareous matter, resume in part their solidity when boiled in oil ; but the same thing takes place with every other substance, with gelatine for example, and there is a great difference between

a bone which combustion has destroyed in part, and that which still contains all its principles.

The ancients said that the marrow served to nourish the osseous texture; but it is sufficient, that there are a great number of bones destitute of medullary fat, to render this inadmissible. The medullary membrane performs on the interior of the bone the office of periosteum; it contains nourishing vessels, and it is in this way only that it contributes to nutrition. As to the marrow, it must have the same general uses as the fat; it is a kind of aliment in reserve, one of the forms in which the nutritive matter is clothed. It serves besides to fill the void which without it would exist in the medullary canal.

Morbid Anatomy of the Medullary System.

The alterations of this system have not been sufficiently studied to enable us to present a complete view of them. We shall here confine ourselves to a mere sketch.

It is very probable, as Bichat says, that the medullary membrane of the long bones is affected in syphilitic pains. In fact, a slight percussion made on the surface of the bone excites these pains, on account of the jar it communicates to the marrow. Besides, we are completely ignorant what kind of alteration this last experiences.

In amputations, the oily matter of the bones is absorbed in the neighbourhood of the wound; the medullary membrane is covered with fleshy granulations, and contributes to the formation of the cicatrix. What takes place after fractures has already been noticed; a sort of hardened plug fills the medullary canal; this canal is afterwards reestablished, unless the union between the fragments be not exact, as when they slide over each other. In necroses which include the medullary canal, when the old bone

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has been drawn out, there remains a reddish membrane which lines the new one ; but the marrow is not reproduced.

Spina ventosa is an affection peculiar to the marrow ; it is a true cancer of the medullary membrane, different from the cancer of the bone and from that which affects the periosteum, but analogous to these affections in its nature. The disease has its seat usually near the extremities ; on the leg, it is towards the superior end, and on the thigh, it is towards the inferior, that it most often exists. It may happen that the osseous texture is at the same time altered ; but frequently this texture is sound and has only experienced a greater or less dilatation, a simple extension. It is then found that the bone forms a covering to the tumour, sometimes enormously dilated, often perforated and traversed by vegetations of a cancerous nature ; this is what I have many times had occasion to observe.

The medullary fat varies much in quantity according to the state of corpulency ; but the medullary canal is always full of a fluid which resembles the marrow more or less. In fat subjects, the marrow has appeared to me to contain, in eight parts, seven of oily and one of foreign matter. This agrees with what has been stated by Grutozmacher. In a phthisical subject, I have seen the fat form only a quarter ; the rest was a serous or albuminous fluid similar to that of which Bichat speaks. It would then be possible, that in extreme emaciation, there might be hardly any fatty matter.

ADDITIONS

TO THE

CARTILAGINOUS SYSTEM.

Peculiar Texture.

Page 243.—" With a little attention we distinguish" (in this texture) " longitudinal fibres, which are crossed by transverse and oblique ones."

It is very difficult to see these fibres distinctly; every thing appears to be homogeneous in a cartilage cut through, as Bichat observes. The only thing which denotes organization in it is, that an oozing of serum takes place, at the end of a short time, upon the divided surfaces, which indicates that there were fluids in circulation in it. This oozing is more abundant as the subject is younger.

Various facts seem to show that there is a peculiar arrangement in the cartilaginous texture; on this subject

there are different opinions. Duhamel thought that this texture was composed, in the cartilages of ossification, of concentric laminæ superadded to each other, from the formation of the successive osseous layers which his experiments with madder had demonstrated to him. These experiments have been noticed elsewhere; we have seen what must be concluded from them in relation to the growth of the bones. They in no wise prove the arrangement of which we are treating, since the layers are only formed on the surface of the bone, when this is once completely developed; we find neither plates nor layers of any kind in the pre-existing cartilage.

Hunter and Delassone say that the fibres of the cartilages of the moveable articulations are perpendicular for the most part, and implanted in the bones of these articulations; they compare the appearance which results from it to the texture of velvet. The greater facility with which these cartilages break in the direction of their thickness, the perpendicular direction of the fibres which is seen in them when they are cut in this direction, and maceration, which, if sufficiently long continued, renders these fibres distinct, are, it is said, the reasons upon which this opinion is founded, which cannot be entirely rejected; for the structure which has just been described becomes sometimes apparent in diseases. I shall say only in regard to the second fact, that the traces, which the instrument employed to make the section of the cartilage leaves, have no doubt been taken for fibres.

According to Hérissant, the cartilages of the ribs are formed of laminæ twisted into a spiral form, and it is to this arrangement that they owe their elasticity. This author cites maceration as a proof of what he advances. His observations on this subject require confirmation.

Finally, some appear to have been deceived by the changes which the cartilages undergo when they are on the point of being ossified. It is thus that Mascagni admits in the costal cartilages laminæ in the form of rays, because he has found in the centre of these cartilages a sort of marrow separating these laminæ. But they exist only in adults and in cartilages which have been exposed to desiccation; now, the cartilaginous texture, taken at this period, is not perfectly homogeneous; its exterior, more compact, dries quicker than the interior, and cannot contract, when this still tends to diminish in size; there results from this, spaces which are produced in the centre. We ought also to attribute to the commencement of ossification, owing to the progress of age, the reddish and areolar cavities which Morgagni and Portal have described as inherent in the structure of the cartilages.

The membranous cartilages of the nose and the ear, which will be noticed under the fibro-cartilaginous system, have, according to Soemmering, distinct little fibres, when they have been macerated a month.

Chemical Composition.

Page 244.—" Ebullition upon the articular extremities, breaks it," (the cartilaginous texture,) " and raises it by layers which it softens, and which finally it melts almost completely."

The cartilages of the sutures are likewise dissolved in boiling water and furnish a sort of jelly, like the diarthrodial cartilages; all the others resist ebullition, and do not give out gelatine in this case unless they contain osseous points. This accords with what is known at the present day of the composition of the cartilages. Haller thought

that they were formed of water, gelatine, and an earthy substance; but modern chemists have obtained different results. Mr. Hatchett has found in the cartilages albumen and the phosphate of lime. M. Chevreul has given the analysis of the cartilaginous bones of the Squalus Maximus; they contain, according to his researches, mucus, oil, acetic acid and various salts. Finally, according to J. Davy, there is in the cartilages 44,5 of albumen, 55,0 of water, and 0,5 of the phosphate of lime.

Moreover, this composition must vary at the different periods of life, as well as the proportion of the constituent principles. The cartilages of young subjects contain more fluids, as may easily be proved by drying them comparatively with those of an adult. They are reduced almost to nothing in this experiment, whilst the second lose much less of their size. We see besides in combustion, that there is scarcely any ashes left of the first, whilst the others give an abundant earthy residue.

MORBID ANATOMY OF THE CARTILAGINOUS SYSTEM.

I. *Alterations in the External Forms.*

The articular cartilages are sometimes swelled and softened in white swellings, at other times detached in part, hanging in the articulation, and often destroyed to a greater or less extent; this destruction, frequent in the diseases of the articulations, may bring on anchylosis. In some cases the articular cartilages seem to have entirely disappeared, and there are only found osseous surfaces like ivory; is the cartilaginous texture ossified in this case as Bichat says, or has it been destroyed? It is diffi-

cult to determine this. These same cartilages exhibit frequently after rheumatic affections and in consequence of chronic engorgements, species of floating fibres, loose at their extremity ; it is these fibres which seem to favour the opinion of Hunter and Delassone upon the structure of the cartilages. The cartilaginous texture seems to be decomposed in this case, unless this alteration be regarded as the result of a partial erosion.

II. *Alterations in the Organization.*

Inflammation has never been observed in the cartilages ; in no case are the vessels of these parts coloured with blood ; white fluids alone appear to be capable of accumulating in them. Ulceration however, which does not spare the articular cartilages, as we have just seen, is a proof that inflammation may be developed in them.

Denudation and wounds, which everywhere else are followed by inflammation, do not produce this effect in the cartilages. When they are laid bare in a wound of the soft parts, this reunites by adhesion or by cicatrization, according as the flap has been reapplied or not ; but the cartilaginous texture does not participate in the work of reunion, as J. Hunter and J. Bell have seen ; it remains insulated, covered by the cicatrix, without in any way adhering to it. When an articulation is opened in a living animal, the cartilage does not inflame nor redden, whatever may be the duration of its exposure to the contact of the air ; only if the experiment is prolonged, we see the synovial membrane, red at first in the other part of it, inflame also over the cartilage, and the redness of this membrane extends gradually towards the centre of the cartilage. Yet broken cartilages reunite, as Autenrieth first discovered in the costal cartilages. Different

observers, Messrs. Magendie, Lobstein and myself have recently confirmed this fact. But the part of the cartilages is purely passive in this case. When those of the ribs are fractured, if the two ends remain opposite, an osseous band is formed around them and keeps them in contact; if, as is most common, the fragments have slid upon each other, a band, at first fibrous, then cartilaginous and osseous, holding to the perichondrium, fills the space between them; but in this case, as in the other, they are merely contiguous. It is only in old age, when the cartilages are upon the point of ossifying, that they reunite, like the bones, by a true intermediate callus.

Ulcers of the diarthrodial cartilages are sometimes the seat of a process of separation which resembles, to a certain extent, that of the wounds of the soft parts. There is then found cartilaginous portions newly formed in the place of those which the erosion had destroyed. This affection has been taken by some for an original defect of conformation; it is evidently only secondary.

The osseous transformation is the only one which the cartilages experience; but they experience it almost necessarily with age, and almost without departing from the natural order. Besides, we distinguish, in this respect, two kinds of cartilages; one, merely temporary, becomes ossified in the first year; the other, which continues a longer time, is called permanent, but only in relation to the first, for the cartilages of this kind also finally become ossified; the cartilages of the moveable articulations are perhaps the only exception. But their ossification does not take place regularly nor at fixed periods, like that of the temporary cartilages; it may be delayed to a very advanced age. Keil has seen the costal cartilages not ossified in a man of a hundred and thirty years; Harvey has made the same observation upon

another of a hundred and fifty-two. Besides, the mechanism of ossification is the same for all the cartilages.

III. *Alterations in the Development.*

The cartilaginous system is subject to a small number of defects of conformation; the costal cartilages sometimes exhibit these irregularities.

The preternatural development of this system has already been noticed; we shall advert, in the synovial system, to the foreign bodies of the articulations and to the true mechanism of their formation. The cartilaginous productions differ, like all the others, according as they appear to be deposited, as it were, in the interstices of the organs, or as they are owing to a transformation, which one of them has undergone. Insulated cartilaginous masses have been found in various parts. More often still various organs become cartilaginous. M. Laennec has met with this transformation in the urethra; I have observed it in the vagina, in consequence of inversion of the womb; I have also seen it in the prepuce, in a case of phymosis.

ADDITIONS

TO THE

FIBROUS SYSTEM

Yellow Fibrous Texture.

Page 269.—" They appear" (the ligaments placed between the laminæ of the vertebræ) " to contain much less gelatine, and to be entirely different in their nature."

These ligaments belong, in fact, to a division of the fibrous system, confounded for a long time with the other organs of the same name, but which differs from them in a great number of characters ; I shall now speak of the yellow or elastic texture. It will be necessary then henceforth to divide the fibrous system into two great classes ; one will comprehend the white fibrous organs or albugineous one of M. Chaussier, the other the yellow or elastic ones. The last expression is perhaps better adapted than the first to designate this kind of texture, as its elasticity is its principal character, whilst the colour

is not as essential to it. Besides, no one that I know of, has given a complete description of this texture; it has hitherto only been noticed in unpublished lectures. M. Chevreul, it is said, is engaged in examining its composition.

This texture is met with wherever a resistance is required to be continually in action, a sort of perpetual antagonism, differing in this respect from the ordinary fibrous texture, whose resistance is, as it were, passive, and which is only brought into exercise by distension, and from the muscular, which only resists as long as its contraction continues. It is found in animals under the same circumstances. The posterior cervical ligament of quadrupeds acts so as to oppose the weight, which incessantly tends to bend the head. A covering of the same nature strengthens the abdominal parietes in the same animals, and prevents them from yielding to the weight of the viscera. The whole genus *felis* has an elastic ligament inserted in the claw, keeping it extended, when the animal no longer contracts its muscles to render it prominent. The shells of the bivalves, oysters, muscles, &c. are opened by means of an analogous fibrous texture, when the muscles which shut them are relaxed. In man, besides the yellow ligaments of the vertebræ, we should also enumerate among the organs which this texture contributes to form, the peculiar membrane of the arteries, veins, lymphatic vessels, excretory ducts, air tubes, the fibrous covering of the corpus cavernosum, the urethra, and perhaps also that of the spleen. All these parts require an incessantly active force, opposed to distension, which makes them contract as soon as the contrary effort ceases to have the ascendancy.

The fibres of the elastic texture have the same arrangement as those of the white fibrous texture. Their colour

borders more or less upon yellow; it is more evident in the dead body. Their tenacity is less than that of the other texture; their elasticity, on the contrary, is greater. The vessels of this texture are few.

Stewing does not resolve it into gelatine, like the white fibrous texture. It appears to contain much fibrin, joined to a little gelatine and albumen.

Its properties are slightly marked, except elasticity and resistance, which especially characterize it. It does not appear to be sensible, or at least it is not so, like the fibrous system in general, except to certain kinds of impressions. It is rarely ossified. Its functions are to serve as a connexion or covering, and to perform at the same time the office of a spring, which obeys extension and contracts quickly when the extension ceases. This is what is very evident in the arteries; the column of blood which they contain, moved at each contraction of the ventricles, stretches the parietes of these canals; but the instant after, elasticity contracts these parietes; hence the course of the blood is continuous, whereas it would be interrupted if the heart was the only agent of impulse, as we have said elsewhere.

MORBID ANATOMY OF THE FIBROUS SYSTEM.

I. *Alterations in the External Forms.*

The ligaments and tendons become thick and soft in white swellings; they are then brittle, if we may so say, and yield to the least efforts made upon them. The

surrounding cellular texture is often confounded with them and with that of the neighbouring parts, which takes from them their mobility, and explains in part the immobility of their situation and the embarrassment of the motions which almost always accompanies these diseases. In other cases, as in some contractions, the motions are prevented by the rigidity which the tendons acquire, and by the difficulty with which they are stretched. The ligaments have a similar rigidity in false anchylosis.

II. *Alterations in the Organization.*

Inflammation of the fibrous parts is but little known. That of the periosteum is the most common ; it performs a very great part in many of the diseases of the bones. I have seen several tendons the seat of slow engorgement, which had sometimes been evidently the consequence of an acute inflammation, such as that produced by a puncture, for example. I have myself had an affection of this kind which was produced by a puncture on the hand ; a tumour formed in the extensor tendon of a finger and continued a very long time.

It is particularly in ruptures of the tendo Achillis that we have occasion to observe the mode of reunion of the fibrous organs when divided. A coagulable matter of the nature of albumen or fibrin is then poured out, which gradually increases in density, till it finally unites with solidity the two ends ; this substance, soft and extensible in the beginning, is capable of being elongated at this period, as happens in fact when the limb is too much moved. The rupture of the ligaments almost always takes place in luxations ; but what takes place after the reduction of these last has not been described.

Ossification is rare in the fibrous texture. The kind of hardening which this texture undergoes in old age hardly ever extends so as to produce this transformation; it scarcely ever takes place except in the tendons, at the places where there is friction, and in the ligaments, at their extremity attached to the bones. It is not the same in some animals; in the gallinaceous ones, for example, the tendons of the muscles of the feet are uniformly osseous at a certain period.

The periosteum is sometimes affected with cancer, as is seen in what some call *the fungus or medullary fungus of the periosteum, others the bony tumour, lymphatic tumour of the periosteum*, &c. Other fibrous organs, as the dura mater, exhibit analogous tumours. Periostosis differs from these tumours in this, that it is the effect of an exudation which takes place below the periosteum detached from the bone; the matter of this exudation becomes sometimes more and more consistent; we have seen that it may become osseous.

III. *Alterations in the Development.*

Certain defects of conformation are accompanied with an extreme relaxation of the ligaments which unite the bones, of which club-feet furnish an example; the relaxation in this case is but a secondary circumstance, which is owing to the weakness of some of the muscles.

The fibrous texture is produced under many circumstances. 1st. Without speaking of its reproduction when it is divided itself, the cicatrices of various organs are essentially fibrous; this is what we have already seen under some circumstances in the bones, and what we shall see hereafter in the muscles and the skin. 2d. The cellular texture, the retina, the substance of the tes-

ticle and the thyroid gland are sometimes changed into the fibrous texture. 3d. Various fibrous productions are developed in the substance of the organs. They assume the form of membranes, as in cysts, fasciculi, as in the ligaments of the false articulations, or they are masses known by the name of *fibrous bodies*. These bodies are especially met with in the uterus; Bichat mentions them. They occupy different points of the substance of this organ. Their number varies; many are often found. At first very small, they gradually increase in size, and become in some cases considerably large. Their fibres form layers nearly concentric, and appear as if wound like balls; they receive vessels more or less apparent. These bodies often pass to the fibro-cartilaginous state; but this state is not peculiar to them, as has been said. Ossification even may seize upon them; they then resemble stones or concretions. Sometimes they are entirely detached and fall off, either into the cavity of the periosteum, or into that of the uterus; they form, in the second case, the pretended calculi of the womb, of which many examples are found in a memoir by Louis inserted among those of the Academy of Surgery. The fibrous bodies of the uterus have been known for a very long time; Chambon gave them the name of *scleroma*. But it is especially to Bichat, whose ideas upon this subject have been published by M. Roux, and to Bayle, that we are indebted for a more accurate description. Analogous fibrous bodies have been found in other parts, as in the neck and in the substance of the fingers. It is not unusual to find around the vagina, between the bladder and this canal, between the latter and the rectum, or in its parietes even fibrous tumours, which, in truth, differ a little from the preceding. They have not the knotty appearance of these last; their texture, soft and flexible,

has some resemblance to that of ordinary polypi. But they do not arise like them; their adhesion to the neighbouring textures is slight, so that their extirpation is not difficult. M. Pelletan cites examples of this affection; M. Dubois has observed it a great number of times; I have myself seen many of these tumours. Their structure deserves to be examined thoroughly. It is important to know them in practice, because if care be not taken, mistakes on this subject may be committed.

ADDITIONS

TO THE

FIBRO-CARTILAGINOUS SYSTEM.

Of the Nature of the Membranous Fibro-Cartilages.

Page 316.—" It is not only in its form, but also in its nature, that this class" (viz. that of the membranous fibro-cartilages) " differs from the others as we shall see."

This nature is perfectly analogous to that of the cartilages, which the membranous fibro-cartilages resemble in all their characters, as may be easily seen by comparing, in the history of the fibro-cartilaginous system, their properties with those of the other bodies which are classed under it. Thus Meckel in his General Anatomy, observing entirely the distinction established by Bichat, between this system and the cartilaginous, places these organs in the latter under the name of *membranous cartilages.*

I am entirely of his opinion. In fact, 1st, like the cartilages, and the pretended membranous fibro-cartilages they seem to be homogeneous in their structure, and have no evident fibres. Those which cover this surface belong to the perichondrium, which is very thick upon these cartilages; when stripped of this membrane, they have the appearance of the cartilaginous texture. 2d. Gelatine cannot be extracted from them by ebullition, as from the other fibro-cartilages. They are on the contrary in this respect like most of the cartilaginous textures. Desiccation also acts upon them nearly as upon these last. 3d. Most of the fibro-cartilages are destitute of perichondrium; these have it very distinct, as I have just said. It is to the fibrous texture which covers them that these cartilages owe their suppleness, the only property which they have in common with the fibro-cartilages.

Of the forms of the Fibro-Cartilaginous System.

Page 316.—" These three classes of fibro-cartilages," (the membranous, articular and those of the tendinous sheaths,) " though very analogous, have not exactly the same structure, the same vital properties, nor the same life, &c."

If the first class be rejected, in conformity with what has been said above, there will remain the articular fibro-cartilages and those of the sheaths of the tendons, which are in fact very different from each other. These differences appear to have their source principally in the different proportions in which the fibrous and cartilaginous textures are in this system; whence results a more or less perfect resemblance to one or the other of these tex-

tures, a more or less evident fibrous structure, resistance and flexibility, or, on the contrary, more or less elasticity and homogeneousness. The following table may be made of the fibro-cartilaginous system, by adding to the forms pointed out by Bichat, that of the rings of this nature in which the superior extremity of the radius and the tendon of the great oblique muscle of the eye slide, and of the bands, also fibro-cartilaginous, which increase the depth of certain articular cavities.

FIBRO-CARTILAGES.

- ARTICULAR. They are in relation with the articular surfaces of the bones, and perform various uses towards them. Those of the diarthrodial articulations are embraced by the synovial membrane of these articulations. They may be divided into
  - Free ; example, that of the lower jaw.
  - Adherent : These are so
    - By their extremities, as that of the clavicle, of the inferior extremity of the ulna, those of the knee, &c.
    - By one of their surfaces, as the bands which are attached to the edge of the glenoid, and cotyloid cavities.
    - By their two surfaces ; such are the inter-vertebral substances, those of the pubis, sacrum, &c.
- OF SLIDING. Their name indicates their use ; almost all are connected with the tendons. They are
  - Flat ; those of the tendinous sheaths or of covering.
  - Circular ; the pulley of the great oblique muscle of the eye, and the annular ligament of the radius ; this serves besides to close the articulation of this bone.

MORBID ANATOMY OF THE FIBRO-CARTILAGINOUS SYSTEM.

I. *Alterations in the External Forms.*

The inter-vertebral substances are sometimes found in diseases remarkably swollen, softened and engorged with fluids; which produces a greater mobility and less solidity in the vertebral column. The symphysis pubis still more evidently undergoes this alteration in pregnancy.

II. *Alterations in the Organization.*

The organic affections of the fibro-cartilages are but little known. Yet ulcerations have been seen in them; Messrs. Palletta and Brodie have described a variety of vertebral diseases which commence by the erosion of the inter-vertebral fibro-cartilages.

The manner in which these organs are repaired when they are divided, has not been ascertained. It might be easily seen, for example, after the operation of the division of the symphysis pubis.

As to the ossification of the fibro-cartilages, a distinction may be established here, as in the cartilaginous system, founded upon the period at which this ossification takes place. There are in fact, temporary fibro-cartilages which serve as moulds for the bones, as there are cartilages of this name; these are regularly ossified, and this transformation is for them only a consequence of their natural development. These fibro-cartilages of ossification are met with where bones are developed in the fibrous textures, as is seen in the article on the osseous

system, with regard to the sesamoid bones; the osseous points of the stylo-hyoidean and thyro-hyoidean ligaments are also formed in this manner. On the contrary, the permanent fibro-cartilages rarely pass into the osseous state. This sometimes happens as has been said, with regard to those of the vertebræ; yet oftentimes in these cases, the external layers alone are invaded. At the pubis, this phenomenon is extremely rare; it is a little less so in the sacro-iliac symphysis and in the sacral articulations. The fibro-cartilaginous organs seem to be, in this respect, intermediate to the cartilaginous and fibrous textures, as they are so in many others, they are ossified less often than the first, but more frequently than the second.

III. *Alterations in the Development.*

There are preternatural fibro-cartilages, 1st, in the cure of some fractures badly kept in place; 2d, in false articulations, in consequence of which the periosteum often takes this form; 3d, in alse anchyloses, which are sometimes produced by filaments of the same nature; 4th, finally, in cysts, in tumours of the uterus, the thyroid gland, &c. and in which are often found some fibrous, fibro-cartilaginous parts, &c.

ADDITIONS

TO THE

MUSCULAR SYSTEM OF ANIMAL LIFE.

Intimate Structure of the Muscles.

Page 335.—" I would compare the anatomical researches upon the intimate structure of the organs, to the physiological researches upon the first causes of the functions. In both we are without guides, without precise and accurate data; why then give ourselves up to them?"

Notwithstanding the little apparent utility which these researches seem to have, since many learned men are still engaged in them, I thought it might be satisfactory to find here a short analysis of the labours and opinions of which the muscular fibre has been the object.

Some consider it divisible almost ad infinitum; Muys says that each fasciculus must be divided and subdivided eight times before we can arrive at the ultimate muscular

fibre; others, Prochaska for example, think that these divisions are much too numerous. There is the same difference of opinion as to the size of this fibre. It is less, according to most authors, than the globules of the blood. Sprengel, who has measured it by the micrometer of Banks, attributes to it, on the contrary, a much greater diameter, which he considers to be equal to the fortieth of a line in the mammalia, and to the twentieth in birds and fishes.

The muscular fibre appears to be unequal and as it were wrinkled on its surface, which has been variously explained. It has been said that these inequalities were the mere effect of muscular contraction; that they were owing to the contractility of texture of the cellular and vascular parts which surround the fibre; that it is a consequence of the knots and contractions, of which this is composed. This last opinion is best founded in insects, which exhibit evidently in their fibres this kind of knotty appearance; but it is not by any means, so evident in man. Meckel, who has seen this arrangement very clearly in the first by the microscope, has not been able to detect it in the second. The muscular fibre has appeared to him in man, to be nearly uniform and of the same size in all its points; only there is always observed in it globules or opake points, separated by a more transparent medium; which is very different from the knots Home has also observed globules in the muscular fibre. By examining this fibre, deprived of its cellular texture by ebullition, as it should always be when we would study it by itself, and by maceration, he has seen it reduced to round particles precisely similar to the globules of the blood.

Various observers have examined with the microscope the transverse section of a muscle. The surface of this

section resembles very much that of basaltic earth ; the fibres are compact, flattened, and prismatic rather than cylindrical. A very good idea of them may be formed from a plate which Prochaska has given.

Is the muscular fibre solid or hollow ? This is a question with which anatomists have been much engaged, though it is hardly possible to answer it by inspection. Thus there has been scarcely any thing but suppositions formed on this subject. However, Lecat, Verheyen and Vieussens are all agreed upon this point, and have believed that it might be concluded from their observations that each fibre of a muscle was an assemblage of vessels of a particular order, continuous with the arteries and the veins at the place where these two orders of vessels are confounded, but placed out of the circulation of the latter. These vessels, which might be called *vessels of derivation*, are admitted by Mascagni ; they are the same that Bleuland says he has found in the capillary system in general, and in other parts as well as the muscles. Haller, on the other hand, rejects this opinion. All those, who like him, divide the parts into those that are capable of being injected and those that are not, and this is the case with the greatest number of anatomists, think that the muscular fibre is solid and beyond the circulation of the fluids.

Influence of the Nerves upon Muscular Irritability.

Page 384.—" The duration of this last property," (sensible organic contractility,) " after the experiment I mentioned," (the division of the nerves,) " proves completely that the nerves are wholly foreign to it, that it resides essentially in the muscular texture, that it is, as Haller said, inherent in it. Thus whilst in the different

paralyses the muscles lose the power of obeying the cerebral influence, or rather this influence becomes nothing, they preserve that of contracting in an evident manner when stimulated."

When all the nerves of a muscle are cut, the muscle preserves only for a time the faculty of obeying the action of stimuli; the contractility is soon exhausted and does not reappear. On the contrary, when the communication with the nervous centres is free, the irritability diminishes also in proportion as it is put in exercise, and finally, as in the preceding case, disappears entirely; but if the animal is suffered to rest, it is reproduced. Hence it would seem, that this property is not inherent in the muscle, but that it is entirely subjected to the nervous influence. The duration, besides being shorter, of the irritability after the division of the nerves may very well depend upon the influence of these nerves below the division; an influence which can continue but a little time, not being renewed, from the want of communication with the nervous centres. According to this idea, which is that of Platner, Legallois, &c. the muscles only put in action a principle which is brought to them by the nerves, and these perform a double part in the contractility of the muscular texture; 1st, they keep this texture in a state of constant excitability for the sensible organic contractility; 2d, they transmit the excitement under certain circumstances, as it respects the will, for the animal contractility. The muscles are to the nervous system what the senses are to this system, parts whose action is intimately connected with its own, and becomes nothing without it. And in fact this action, in the first as in the second, is exhausted, lost and reproduced nearly in the same manner. Sleep, rest and food

reestablish the muscular energy when weakened by long exercise, as they restore energy to the senses when theirs has been destroyed by the same cause. We have just seen that this does not appear to apply solely to animal contractility, but also to sensible organic contractility, or irritability properly so called.

However, all physiologists are far from being agreed in the above opinion. A great number have followed the opinion of Haller, and attributed to the nerves, no other use in contractility, than that of conducting the stimulus when it comes from the brain. They rely upon this, 1st, that Tourdes has ascertained that there is motion in pure fibrin; 2d, that vegetables and zoophytes contract, though they are evidently destitute of nerves; and 3d, that contractility is put into action in the muscles by stimuli which are directly applied to them. But, 1st, in admitting the experiment of Tourdes, which no one since has confirmed, its results are very different from those of muscular contractility; 2d, vegetables and animals without nerves are also without muscles, thus their contraction has nothing in common with the latter; 3d, the last argument is in part combatted by all the reasons alleged above in favour of the opposite opinion. It is very difficult, however, to resolve the question in an absolute manner. We find in Meckel a sort of mixed opinion, which is perhaps the most accurate. According to this author, the nervous influence is one of the conditions necessary to contraction, but it only operates like the blood which the arteries bring, being like it indispensable to the life of the muscle, which does notwithstanding possess its irritability of itself.

Quickness of the Muscular Contractions.

Page 395.—"When it is the will that regulates the quickness of the muscular contractions, this quickness has infinitely various degrees; but there is always one beyond which we cannot go."

This quickness is in general very great; it becomes sensible especially in the action of playing upon different instruments; it is found by estimating how many different movements each note of music requires that there is, in general, a contraction every sixtieth of a second. Dr. Wollaston has obtained the same result in another manner. His researches are given in a Croonian Lecture published in the Philosophical Transactions for the year 1810. The following is the means he adopted to measure the quickness of the contractions.

According to his researches, muscular contraction, however short may be its duration, is, as it were, intermittent, and composed of many alternate small contractions and relaxations; the kind of buzzing which is heard in the ear when its aperture is closed by the extremity of the finger, is a proof of it. This peculiar noise is owing, according to Dr. Wollaston, to the muscular effort which the attitude requires; and in fact I have proved that it is nothing when the finger is replaced by an inanimate body. Now, this buzzing includes a series of oscillations very near together which correspond to so many contractions of the muscles; it was only necessary then to find a term of comparison for these oscillations, this Dr. Wollaston has done. He has compared this noise to that which the motion of a carriage produces, which is also intermittent,

and the frequency of which it is easy to estimate. He has ascertained the quickness stated above.

Size of the Muscles in Contraction.

Page 398.—" Their volume" (that of the muscles which contract) " remains about the same. What they lose in length they nearly gain in thickness. Is the proportion very exact? Of what consequence to us is this insulated question, to which, since the days of Glisson, so much importance has been attached! it deserves none."

There are moreover many causes of error in the experiments which have been made on this subject. Swammerdam, for example, says that by placing the heart of a frog in water the fluid is seen to sink at the moment of contraction and to rise in the relaxation; but the heart containing a fluid which can increase or diminish the size of it, without any change in the texture of it, it is evident that nothing can be concluded from this experiment. So in that of Glisson, who immersed the arm of a man in a tub, and afterwards observed the difference of the level according to the state of contraction or relaxation of the muscles, the results cannot inspire great confidence, because on the one hand, it is quite difficult in this case to ascertain precisely the level, and because on the other, the contraction of the muscles being always accompanied by the relaxation of the opposite muscles, it is impossible to distinguish these two effects from each other.

One fact which seems to offer something more positive, was ascertained by Erman. This physiologist, having put a piece of an eel in a narrow tube of glass containing water, saw at each contraction which a stream of galvanism produced, the water evidently sink, and rise again during the relaxation.

Besides, this question, with which authors have been much engaged, has been resolved by them in all ways. Some have maintained that the muscle was diminished, others have pretended that it was increased, and finally others have been certain, that it was neither increased nor diminished; it would be difficult to imagine a fourth opinion.

State of the Circulation in the Muscles during Contraction.

Page 398.—"The blood contained in the vessels of the muscles, especially in the veins, is in part pressed out; the increase of the flow of blood by the motions of the arm in the operation of bleeding proves this fact."

This fact is differently explained by many physiologists, who admit that the circulation becomes more rapid in a muscle that is in a state of contraction, and attribute to this circumstance the increase of the jet of blood by the motions in the operation of bleeding. But the greater activity of the circulation during the muscular contraction is far from being rigorously demonstrated. Let us see in fact upon what this assertion rests.

1st. It is evident that the fact of the bleeding cannot establish this opinion, since we have just seen that it is easy to account for it without being obliged to have recourse to it; in fact, the muscles being increased in thickness in their contraction must necessarily compress the deep-seated veins, by the resistance of the aponeuroses of covering, which then perform the office of a ligature in relation to these veins; hence it is not surprising that the blood goes in greater quantity into the sub-cutaneous veins.

2d. The panting, which always follows great motions, has been cited; it is, it is said, because the circulation of the blood through the muscles is more rapid, and the lungs consequently receive it in greater abundance, that respiration is accelerated in this case; thus the muscles which serve for this function are then in extreme activity, and sometimes finally become so fatigued that respiration can be no longer supported by them, as is seen in animals pursued in the chase, who at last fall down. But it is necessary to take into account here a principal circumstance, omitted in the explanation that has been given of this phenomenon; it is, that the parietes of the thorax, contracted and immoveable, are to serve as a fixed point for the action of all the muscles of the body, in all violent and extensive motions. Now this circumstance explains all the others; the circulation is more rapid, because the vessels being compressed in the chest, less blood can go through them in a given time; respiration is panting, because the permanent contraction of its muscles impedes inspiration, and it is necessary that its frequency should compensate for its want of extent; finally the muscles of inspiration are fatigued by the force with which they are compelled to resist all the other muscles of the body. The more rapid passage of the blood in the muscles is not then, in this case, an immediate consequence of their contraction, but is owing on the contrary to a cause, which to a certain extent is foreign to it.

From these different considerations, it is evident, that nothing proves that the circulation of the blood is more active in a muscle at the time of its contraction, as has however been almost generally thought. The various hypotheses, by means of which it has been pretended that the muscular action could be explained, have no

doubt given rise to this idea, which could never have arisen from observation, and of which it has been thought that proofs were afterwards found, when the imagination had once created it. It is thus, that Prochaska could hardly refuse to admit it, when he supposed, very ingeniously it is true, that the shortening of the muscles in their contraction depended solely upon this, that the vessels placed transversely in the substance of their fibres, suddenly distended by the fluids which entered them, separated these fibres and made them suddenly fold up.

State of the Muscles after Death.

Page 419.—" It appears that these different states" (of rigidity or relaxation) " depend upon the kind of death, upon the phenomena that accompany the last moments. But how do they precisely happen? It is an object of interesting research."

The *Physiological Researches* of Nysten and one of the synoptical tables of Chaussier may be consulted with advantage upon this point. Muscular rigidity is constant after death ; it is a consequence of irritability ; the muscles are in a state of real contraction. This phenomenon appears also to be connected with the coagulation of the blood ; for all the causes which retard or promote the one have the same action upon the other; a warm bath, by preserving the heat in a dead body, and by preventing the coagulation of the fluids, keeps up also the suppleness of the muscles. But what proves that cold is not the sole cause of the rigidity, is that this disappears after some time, and that the muscles are relaxed of themselves before the period of putrefaction. The kind of death has an influence upon the duration of the contraction and the

time in which it comes on. In diseases with exhaustion, such as scurvy and gangrenous diseases, the rigidity appears very soon after death, but soon gives way. On the contrary, after acute diseases and sudden deaths, it does not come on for one or two days, but continues a much longer time; it is also greater in the last case. Besides, the muscles are not the only seat of this rigidity, the cellular texture and the fibrous parts partake of it also. The muscles of organic life experience it, like the external muscles, although it is in the latter that it is particularly observed.

Morbid Anatomy of the Muscular System of Animal Life.

The alterations which the muscles of animal life undergo will be described with those of the muscles of organic life.

ADDITIONS

TO THE

MUSCULAR SYSTEM OF ORGANIC LIFE.

Influence of the Nervous System upon the Muscles of Organic Life.

Page 24, *vol.* 3*d.*—"The cerebral and nervous influence upon the organic muscles is not known to us.—It is however real to a certain extent, since it is necessary that the nerves which enter into the composition of these muscles should be of some use; but we are ignorant of this use."

We have seen in the muscular system of animal life, that the influence of the nerves upon the irritability of this system cannot be easily determined. The same question recurs here, and is even more complicated. In

fact, in the other system, there was at least an evident action on the part of the brain and nerves in animal contractility; in this, this action not only becomes doubtful, but the same difficulty exists, and even a greater one perhaps, in relation to the part which the nerves perform in the organic contractility. It may be asked, 1st, if the brain has any influence upon the contractility of the muscles of organic life; 2d, if the spinal marrow be not necessary to the exercise of this contractility; 3d, if the nerves be purely passive in this phenomenon, so that this property is, according to the expression of Haller, inherent in the fibre of these muscles.

The considerations offered by Bichat show that the muscles of organic life are independent, in their action, of cerebral influence; but they do not prove that this cannot be exerted under some circumstances. Many of the facts which he has brought forward tend, on the contrary, to demonstrate this influence. The passions are a remarkable example of it. It appears to me to be extremely probable that, when in a strong emotion, for example, the motions of the heart are accelerated, it takes place only because the brain reacts upon this organ and transmits to it the impression which it has received. Placing the primitive seat of the passions in the organs of internal life, is forgetting, it seems to me, that the brain is the sole organ of the perceptions, and that the passions are always the consequence of these last. This however is not the place to discuss this question; it is sufficient to show that the action of the heart may in this case be entirely subjected to that of the brain. Those cases, rare ones indeed, in which the will can suspend the action of the first of these organs, seem to belong to the same cause. Bayle, who possessed this singular faculty, could put it in exercise instantaneously and with the same ease that he could

move a muscle of animal life ; now, if this depended on the suspension of respiration, it would require some time for the phenomenon to take place. Moreover, the heart is not the only organ which thus obeys, in some cases, the influence of the brain. Many facts show that the stomach, intestines, bladder and even the womb are also sensible to this influence ; we know not, it is true, if it be by the nerves that it is transmitted; but as these agents are the only means of communication of the brain with these different organs, every thing leads to the belief that such is their use. It must however be acknowledged that we want direct experiments in order to place this beyond doubt. On the contrary, those that have been hitherto made teach us, that the brain can be removed without diminishing at all the action of the muscles of organic life, if care be taken at the same time to support respiration. What can we conclude from these opposite facts and from those stated by Bichat? that no doubt the cerebral influence is not absolutely necessary to the contraction of these muscles, but that it can modify it under certain circumstances. We shall now see that it is nearly the same with regard to the spinal marrow.

On the one hand, Legallois, by numerous experiments which have already been noticed in the article upon the nervous system of organic life, has pretended to prove that the heart receives, by the great sympathetic, from every part of the spinal marrow, the principle of its motion, which is annihilated when this is wholly destroyed ; on the other hand, various facts, which have been stated in this same article, from the experiments of Clift and Wilson Philip, demonstrate that often, notwithstanding the absence of the spinal marrow, the heart continues its action ; that some lesions of the spinal marrow have more influence than others upon this organ ; that, accord-

ing to the age and the species of the animal, great differences in the results are observed, &c. Whence it is seen that the organic contractility, though independent to a certain extent of the spinal marrow, is in some case influenced by it.

Finally, is the continuance of this contractility, notwithstanding the destruction of the brain or spinal marrow, a proof that the muscular fibre is of itself endowed with it, independent of all nervous influence, as Haller thought? Certainly not, since the nerves exist and can still act insulatedly in this case. Nothing is opposed to our admitting here the same hypothesis as in the muscular system of animal life, viz. that the muscles derive from the nervous system the principle of their action; but I know of no fact which proves this in an incontestable manner.

Duration of the Organic Contractility.

Page 38.—"This duration is longer than that of the animal contractility. When the spinal marrow is irritated, the external muscles remain immoveable, whilst the internal ones are still in activity."

This comparison has for its object only the two species of contractility, considered in the two corresponding systems. But that of animal life enjoys not only the contractility of this name, but possesses also, according to the distinction made by Bichat, organic contractility. Now this differs, as it respects its duration after death, in the different muscles of the two systems.

Haller, who perceived this fact, says that it is the heart which remains the longest sensible to the action of stimuli; that next to it, the intestines are the slowest in

losing the faculty of contracting; that the stomach comes next and then the diaphragm, and that finally the external muscles are the first in which this faculty is extinguished. He adds, that in some cases, the intestines appeared to him to preserve their irritability longer than the heart. New researches, for which we are indebted particularly to Nysten, prove that this order is not in fact exact. The kind of death, the nature of the stimulus employed, &c. make the duration of the irritability vary in the different muscles; it is thus that the heart for a longer time obeys the irritation which arises from a puncture with the point of an instrument, whilst the voluntary muscles are longer sensible to the stimulus of Galvanism.

A numerous series of experiments has enabled Nysten to establish the following order, which is very different from that of Haller; 1st, the left ventricle of the heart, which gives for the shortest time signs of irritability, and is thus found at the bottom of the scale; 2d, the large intestines; 3d, the small intestines; 4th, the stomach; 5th, the bladder; 6th, the right ventricle; 7th, the oesophagus; 8th, the iris, whose motions this physiologist has also examined; 9th, the muscles of the trunk; 10th, those of the inferior extremities; 11th, those of the superior extremities; 12th, finally, the auricles, the contractility of which is preserved after this property has ceased in all the other parts; it is extinguished in the last place in the left auricle, a fact very long known, and which is mentioned by Galen.

Force of the Dilatation of the Muscles.

Page 54.—"It appears then very probable that the dilatation of the organic muscles is a phenomenon as vital as their contraction."

Without absolutely denying that the internal or involuntary muscles can be dilated and the voluntary ones elongated, by a peculiar vital action, analogous to the contraction of these same muscles, I would observe that most of the facts which tend to prove this action can be explained in another way, and often depend on causes which are wholly foreign to it, and which have been overlooked by those who admit this action. It is thus that Barthez cites as phenomena of this kind, owing to a sort of active repulsion opposed to the attraction which predominates in the shortening of the muscular fibres, the elongation of the trunk of the elephant, that of reptiles, worms, &c. in the act of crawling, and even that of the tongue. It is evident that, in all these cases, the elongation is but a secondary effect of the shortening of certain muscles, which by their arrangement, cannot produce it except by a real dilatation. The leech, for example, has longitudinal fibres, the effect of which is to shorten it, but as it has at the same time circular fibres which cannot be contracted without elongating it, the space which these fibres enclose evidently increasing in one direction, whilst it diminishes in another. It is the same with regard to worms, &c. The trunk of the elephant also contains two sets of fibres, the longitudinal ones to shorten it, and the radiated ones serve to elongate it, and it is not to the dilatation of the first that this last effect must be attributed.

It is for the want of having known the true arrangement of the muscular fibres in certain parts, and not having appreciated the different effects of the contraction of these fibres according to the direction they take, that some have been led to give them a force of expansion which by no means appears to be inherent in them. What takes place in the intestine confirms this idea;

there is no doubt that the alternate extension and contraction which agitate this viscus depend on the alternate contraction of its longitudinal and circular fibres; yet this fact is one of those which has been given in proof of the active dilatation of the muscles.

F. Meckel has presented some new considerations in support of the latter, drawn from the different states in which the muscles are found after death, from the motions which are observed in the iris, from the variable dimensions of the pupil in the dead body, &c.; but if we except from them the iris, whose motions are, I think, but little known, and whose muscular nature is moreover far from being demonstrated, the contraction alone of the muscles perfectly explains almost all the phenomena of which they are the seat. A single one, already cited by Bichat, seems at first favourable to the active elongation of the fibres, inasmuch as it appears hitherto inexplicable; it is the force with which the heart rises up and tends to dilate itself, even when the blood does not enter its interior. But is this fact, though obscure, more conclusive, and may it not be owing, like the others, to some particular cause which is unknown to us? Who can say that the diastole and systole will not be one day as simple phenomena, as those of the contraction of a voluntary muscle?

MORBID ANATOMY OF THE MUSCULAR SYSTEM.

The alterations common to the two great divisions of this system may be united in one description. There are a few particular ones, which will be noticed.

I. *Alterations in the External Forms.*

Excess of nutrition is common in the muscles; but it is hardly any where but in the heart and the bladder that it constitutes, properly speaking, a disease; it is characterized by a remarkable increase of size and often of density. Atrophy often takes place in the external muscles, from the want of exercise, distension or some other cause. There is frequently joined with it a discolouration of the fleshy fibres, which has been taken for a fatty state, as Bichat has already observed. The pretended fatty alteration of the muscles does not appear to me to exist, at least I know of no instance which cannot be referred to the preceding state, in which, the fleshy fibres disappearing in part, the intermuscular fat predominates and is confounded in its colour with the muscle itself, that has become yellowish. But we find by analysis fibrin in these muscles; by putting some of it on brown paper, distinct fibres are discovered after the animal oil has been absorbed, &c. In the heart, atrophy occasions the dilatation of this organ, its passive aneurism.

The muscles lose their consistency under many circumstances; the heart is very subject to this alteration, which has been described by M. Laennec in his excellent work entitled *Traité de l'Auscultation Mediate,* in which will be found a great number of interesting facts upon the diseases of this viscus. The softening of the

muscles may bring on their rupture; that of the heart has been often observed in similar cases, especially in old people; it has been the subject of a particular work of M. Rostan.

The muscular fibres are sometimes elongated from the effect of different diseases; there results from it a more or less evident weakness of their action. This forced elongation of the muscles often exists at the same time with the shortening of the antagonists, which is then the cause of it; it is sufficient, in this case, to counterbalance the latter in order to restore to the former their contractile faculty; it is in this way that we sometimes succeed in remedying the permanent flexion of the fingers, by straightening them to such an extent that the extensors can contract again; the same thing applies to the cure of club-feet, when it is possible to bring back the axis of the limb to its primitive direction.

Shortening has not the same inconveniences; it may extend very far without being perceived by the contractility, as proved by a preparation in Hunter's collection, in which the humerus had experienced a considerable loss of substance. It seems on the contrary that this shortening power was increased in it; at least it is then in continual exercise. This sort of retraction is very frequent, and is most often connected with a weakness of the antagonists. Contractions from the scurvy, certain morbid curvatures of the trunk, club-feet, that we have just noticed, strabismus, and the retraction of the muscles of the leg by a continual pain in this part, are examples of it. The little finger is often thus retracted.

Much has been said of the displacements of the muscles, of luxations, and hernias of these organs. What Poutean has written upon this subject may be advantageously examined.

II. *Alterations in the Organization.*

Inflammation of the muscular texture is still doubtful. Purulent centres have been found in the different regions of this system, but they may have their seat in the cellular texture interposed between its fibres.

A muscle cut transversely retracts powerfully, as has been seen elsewhere. But the inferior part is often paralyzed by this division, because a nerve is left in the superior, at that part of it in which it usually penetrates the muscle; the latter preserves on the contrary its irritability; the retraction, which is so evident in amputation, depends in a great measure on this cause. It would be the reverse, and the inferior alone would contract if the division had been made higher up. In all cases, to these phenomena succeed those of reunion. A new fibrous texture fills the space between the two ends, which it unites firmly together; if it be short, it does not injure the contraction, otherwise the muscle would gain, as has been said; if the intermediate substance be long and extensible, the motions are more or less injured.

Transformations are hardly ever seen in the muscles. I have however found in them fibrous and osseous tumours, which had a knotty appearance, analogous to that of the tumours of this kind which are found in the womb. We have seen above what should be thought of the fatty transformation.

Morbid alterations (*dégénérations*) are also very rare in this system. Hydatids may sometimes be produced in it; they are common in hogs.

III. *Alterations in the Development.*

The muscles of animal life have been wholly wanting in a fœtus ; there was under the skin, only a fatty mass, formed of infiltrated cellular texture more or less consis tent ; at other times, a part of these muscles is wanting. The heart, in very rare cases it is true, has also exhibited this anomaly, very frequent in some muscles taken separately. Nothing is more variable, besides, than the arrangement of the muscular system, considered in relation to its external forms. We often find supernumerary muscles, or those which should exist are removed, by their conformation, from the natural order. The attachments, direction, size and structure exhibit an infinite number of varieties, all of which are in the province of descriptive anatomy. The muscles of organic life are not exempt from these varieties ; the heart alone exhibits a great number of them.

Some authors have spoken of muscular transformations ; but the examples they have adduced are too vague to be characterized. There seems to be a preternatural development of the muscular texture in the womb, during pregnancy, and in the round ligaments, at the same period.

ADDITIONS

TO THE

MUCOUS SYSTEM.

Villi of the Mucous Membranes.

Page 85.—" The delicacy of these elongations conceals their structure, even from our microscopical instruments, agents from which anatomy and physiology do not appear to me to have derived much assistance, because when we see obscurely, each sees in his own way and according to his own wishes."

A great number of observers, both ancient and modern, agree in many points in relation to the arrangement of these villi ; they differ, it is true, upon others, but it is easy to see that oftentimes the foundation of their observation is the same, and that the whole difference consists in the manner in which they have given an account of

them. The intestinal villi have been the particular object of their researches. The following is what is the least obscure respecting the nature of these elongations.

The villi of the mucous membranes, examined with a microscope, resemble the fibrous parts of the roots of certain trees. Yet their form appears to be rather flat than round, and the name of leaflets *(folioles)* which has been given to them latterly is perhaps better in this respect than that of villi. Lieberkuhn had already noticed this arrangement in man, but he admitted that those of animals were cylindrical, and consequently filamentous or villous. They terminate in a point, which, joined to their flattened form, has led some to compare them, from their appearance, to the leaves of the grasses. Rudolphi says that they are laminæ, small scales which furnish the whole interior of the intestine ; this is not very far from what we have just said.

The structure of these elongations is the point that has been the most contested. We know what was the vesicle of Lieberkuhn ; this anatomist having observed that the intestinal villi were swollen by injection, and that the air driven in diffused itself in them and gave them a spongy appearance, thought that he might conclude from it that they were in a great measure formed of a kind of cellular vesicle, in which the vessels terminated, particularly the lymphatics. Hewson has made observations similar to those of Lieberkuhn, but he has not drawn the same conclusion from them ; according to him, the injection makes the villi swell, and produces in them a phenomenon similar to that of erection ; but this arises from their being entirely composed of a net-work of vessels, of a sort of plexus similar to that which forms the erectile textures. This opinion also is rejected by Rudolphi, Mess. Cuvier, Alb. Meckel and many other modern anatomists, who do

not allow that these elongations contain vessels, at least apparent ones. A viscid matter, a kind of jelly, a substance without form or organization, constitutes, according to these authors, the villi, which have exhibited to them with a microscope only this substance, and moreover opake globules situated below it. This matter is capable of being soaked and then becomes spongy ; this soaking can take place from within, that is to say, on the side of the vessels, as well as from without, or on the surface of the mucous membrane. The lymphatic vessels may arise from this substance, which Alb. Meckel compares to that which constitutes very young vegetables at the period of their development. This description, if it be accurate, would agree very well with the facts previously observed, and would enable us to explain how Lieberkuhn saw a vesicle, how Hewson found vessels, &c. There is, according to Alb. Meckel, a circumstance which may account for the various forms that have been attributed to the villi ; it is that the leaflets they represent are variously folded, and twisted, and thus assume a variable aspect, which depends on their situation at the moment they are observed. It is owing to this that Hedwig calls them cylindrical, *digitiform*, terminated by an obtuse summit; that others have compared them to small clubs, &c.

Many anatomists are confident that there are apertures on the summit of the villi, and that they are the orifices of the lymphatic vessels. They are not however agreed as to the number of these orifices. Bleuland and Hedwig allow but one ; Cruikshank and Soemmering have seen from six to ten. Hewson pretends that these apertures do not become distinct until the villi are rendered more prominent, as happens from injection ; he supposes that it is the same during life, and thus explains absorption by the erection of which he believes these elongations sus-

ceptible. Those, who admit the opinion that was last stated, reject all kinds of openings similar to absorbent orifices; the soft matter, which has been noticed above, is in the place of them, according to this hypothesis.

It is generally thought that the villi receive nerves; but this is rather from a presumed analogy with the papillæ and on account of the sensibility of which they are the seat, than the result of inspection. M. Ribes has injected veins in them from the vena porta; we have seen that these elongations can be injected from the arteries; their lymphatic vessels are also evident; in order to see them, it is only necessary to immerse the membrane in alkohol; the fluids which they contain are coagulated and render them more apparent.

Mucous Glands.

Page 88.—" I cannot say whether nerves penetrate them; analogy indicates it, for all the principal glands receive them."

These small sacs are now distinguished from the glands, and described under the name of *follicles*, which agrees much better with their nature. They appear in fact to be formed by a sort of inversion of the membrane in which they are seated, and which being folded, at the place where they are, beneath its free surface, constitutes in this a real *cul-de-sac*, terminated by an orifice open upon this surface. This arrangement is very evident in the sebaceous follicles on the skin, with which the mucous ones have so great an analogy. These last exhibit it also evidently at their origin; there, as in all the points where their epidermis is distinct, we can raise this up entire with the elongations which it forms in the

follicles. This is rendered still more evident in diseases, as we shall see in the article upon the dermoid system.

Thus the mucous follicles must have a structure analogous to that of the mucous glands of which they form a part, though it is difficult to perceive this structure; they have no excretory duct; only when they are situated below the chorion, in the subjacent cellular texture, the neck of them being more or less elongated, forms a kind of tube. The orifice by which they terminate is uniformly more narrow than their bottom, and furnished with villi similar to those of the neighbouring parts. Sir Everard Home has given very good drawings of these different objects.

Most of these small bodies are insulated and irregularly disseminated, in greater or less number, in the whole extent of the mucous system. I say in the whole extent, for we have seen where they are but little apparent, analogy induces us to admit their existence because secretion is constantly going on there. Besides, their size being excessively variable in the parts which are manifestly provided with them, it is natural to think that if they are not seen in the others, it is simply because their size is such as to conceal them from the sight. Moreover, what reasoning indicates, is already in part proved by inspection; the microscope has enabled us to see follicles in many membranes in which they could not be distinguished by the naked eye, especially in the pituitary membrane; there is produced on the skin little bunches, tumours formed by the development of the follicles, in places where they had not been before met with, &c. But in some parts, the follicles, far from being thus insulated and often discoverable with difficulty, are agglomerated and constitute by their assemblage masses of different forms, and the arrangement of which varies; it is this

which has led to the distinction of the follicles into simple, which are the first, and into compound, among which are ranked the caruncula lachrymalis, the follicles of Meibomius, the arytenoid glands, the amygdalæ, the molar and buccal glands, the *glandulæ agminatæ* of the intestines, the prostrate, &c. Sometimes each of the simple follicles which compose these last, has its own orifice open upon the mucous surface, as is seen in the caruncle. Sometimes, as in the glands of Meibomius, they open into each other, so that the last pours out the product of the secretion of the whole. Sometimes their openings are met with at the bottom of a sort of fold which the mucous membrane makes, an example of which is furnished by the amygdalæ; the mucous lacunæ belong also to this last kind ; they may be considered, as well as the mucous folds of the amygdalæ and the foramen cæcum of the tongue, as great follicles which receive smaller ones ; this is very well seen in the urethra, for example. Finally, the molar glands and the prostate have a real ramified excretory duct, like the glands ; thus these organs partake of the glandular nature, and theirs seem as it were, to hold the middle space between this and that of the follicles properly so called.

The mucous membrane of the stomach, that of the oesophagus and of the small intestines exhibit, besides these follicles, small superficial cavities, slight depressions, which Hewson, who first observed them, compares to the cells of the bees, and designates this arrangement by the name of the *alveolar structure*. These alveolæ have been more recently described by Sir Everard Home ; they can only be seen with a microscope ; in some places, however, they are visible to the naked eye. They do not appear to differ from the follicles but in this, that their aperture is broader than their bottom, the fold

of the mucous membrane being of small extent, which forms them; they are, as it were, the rudiments of the follicles. Their number is few at the bottom of the oesophagus, where they begin to be perceived, between the folds of this canal; it increases in the stomach and especially in the duodenum; in this intestine and in the stomach, the depressions have nearly the same breadth as the interstices between them; they differ in this from the alveolæ or bees' cells which are in fact more numerous, and whose interstices are much smaller. Their parietes are smooth and rounded in the oesophagus and in the neighbouring portion of the stomach; they become unequal as we examine towards the intestines, and are furnished with small leaflets (*folioles*) that are more and more evident.

Sir Everard Home has examined with a microscope the digestive surfaces of different animals. It follows from his observations, that, in animals who are nourished by vegetable substances, the follicles of these surfaces have a more complicated structure, are provided with numerous villi at their orifices, and secrete a more active juice; that animals, on the contrary, whose nourishment is derived from the animal kingdom, have only the alveolar depressions for follicles; that we may distinguish, in this respect, three species of follicles which exhibit three different degrees of complication; 1st, those which pour out a fluid of very great activity, such as those in the ostrich; 2d, those of man and the other omnivorous animals; 3d, those of which we find the type in the Java swallow, which furnishes a matter that possesses scarcely any solvent power, and has in return very evident nutritive properties.

The secretion which takes place in the mucous glands, united to that of the sebaceous glands, constitutes one of

the three principal kinds of secretion established by M. Chaussier in his synoptical tables viz. the *follicular secretion.* It differs in fact in many characters from the perspiratory secretion or exhalation properly called, as well as from the glandular, which it resembles in others; 1st, as in the first, the secreted fluid appears to be brought directly by the extremities of the arteries; 2d, this fluid, after having remained a certain time in the cavity of the follicle, and having no doubt been elaborated there anew, is thrown out, as in most of the glands, by the peculiar action of the organ which has furnished it.

Development of the Mucous System.

Page 125.—"The development of the mucous system follows in general the laws of that of the organs to which it belongs. Early in the gastric apparatus, later in the pulmonary and that of generation, it seems in its growth rather to obey the impulse it receives, than to give one to what surrounds it."

The arrangement of the mucous system is very different in the first periods of conception, from what it will be afterwards. This system appears to be continuous at this period, as well as the cutaneous, with the membranes of the ovum; such at least seems to be the result of the observations of Wolff, Oken, Meckel and others.

Wolff has traced the development of the intestine in the chick. He has seen that this canal is at first very short, straight, open before, and continuous in this direction, with the vitellary membrane, not having any very precise limit to indicate the place where one terminates and the other begins; that afterwards a contraction de-

signates this place, which is elongated more and more, in proportion as the intestine grows at the expense of the yolk, so that at birth these two parts hold together only by a narrow pedicle, which disappears completely when the yolk has been entirely absorbed. Now, the umbilical vesicle appears to perform in man, in the first periods of the intra-uterine life, the same uses that the yolk or the vitellary membrane does in birds; many direct facts tend even to prove, that it is in the same relation as this last to the intestine, though it may be very difficult to be sure of it, because these first periods are passed very rapidly in the mammalia, and the fœtus soon acquires another mode of existence, wholly different from that of birds. However, 1st, the umbilical vesicle is so much the larger in relation to the fœtus, and so much nearer the umbilicus, in proportion as the embryo is younger; 2d, the intestine is for a long time in part contained in the base of the umbilical cord, and afterwards sends sometimes an elongation which extends to the umbilicus; at other times there is seen a small duct detached from the umbilical vesicle, and directed from the side of the umbilicus, for a certain distance, along the cord; 3d, various anatomists have seen this vesicle communicating with the intestine in fœtuses of the mammalia; 4th, Meckel says that he has met with a similar communication, in man.

From all these considerations, it may be admitted, with Oken, Meckel, &c. that what is evident in regard to birds, reptiles and fishes, takes place also in man, and that the alimentary mucous membrane, by being confounded with the umbilical vesicle, makes, in the beginning, an integrant part of the ovum. The same may be said of the genito-urinary membrane, the bladder having intimate connexions with the allantois; the skin,

on its part, making a continuation with the amnios. From this it results, 1st, that these organs are among the earliest in their development, if they be not even formed before all the other parts ; 2d, that the embryo is in nowise distinct from the ovum in the first periods ; 3d, that its two integuments, viz. the external formed by the skin, and the internal which the mucous membrane represents, instead of imitating, as in the adult, a double continuous sac, folded at its two extremities, are as it were but two semi-canals whose circumference is wanting in front.

The part of the intestine, which corresponds originally to the umbilical vesicle, and which serves as a point of departure for the development of the rest of the canal, remains to be determined. According to Oken, it is the cæcum ; and from this point the vesicle sends two elongations which form the stomachal and anal intestines. Meckel thinks that it must be the ileum, because it is so in birds, and because this intestine often exhibits appendices which are regarded as remains of the vesicle, and because moreover the cæcum does not exist in all the mammalia. It is evident that these are but conjectures.

Besides, if it be true that the mucous system commences by having the arrangement we have pointed out, great obscurity still hangs over the manner of its ulterior development, and the way in which this semi-canal, of a very limited length, open in its whole extent, is completed in front on the one hand, and is changed on the other into a long tube, no longer holding to the vesicle but by a narrow and almost impreceptible canal. It has also been attempted to explain in another way the formation of this system. Some have said that the cavities which it lines are hollowed out from without inwards, and that it was the skin, by plunging gradually

into the substance of the embryo, which gave rise to the mucous membranes ; it is on this account, say they, that the intestine is subject to interruptions in its continuity, when its two portions, going, one from the mouth, and the other from the anus, are not perfectly united. There is nothing to prove this assertion, which is also contrary to many facts. Lucae has given another hypothesis, founded upon this, that the cavity of the intestine is often interrupted in many places ; this proves, according to him, that this canal is at first composed, like the vessels, of insulated parts, which afterwards go to meet each other, and are finally confounded. The appendices of the intestine are formed when these parts, instead of joining to the end, are united together by one of their sides. Tiedemann and Meckel admit this opinion to a certain extent, modifying it in that part which makes the intestine proceed from the umbilical vesicle. On the whole, it appears that new researches are required on this point ; only the occlusions of the intestinal tube do not appear to me by any means to demonstrate what authors have advanced ; these occlusions do not take place till after the complete development of the intestine.

There are neither mucous villi nor folds in the first periods of conception. Meckel states that the villi commence by longitudinal folds, which are afterwards divided into small insulated prominences, to form them.

MORBID ANATOMY OF THE MUCOUS SYSTEM.

I. *Alterations in the External Forms.*

The mucous ducts are dilated and contracted under many circumstances; most of these have been noticed in the article on the *Properties of Texture* of this system. These changes of dimension in diseases almost always depend on an obstacle to the course of the substances which pass through these ducts in a state of health; this is evident with regard to the excretories; the least extensible, such as the urethra, may form, in this case, sacs or dilatations of more or less considerable size, before breaking; the bottom of the mucous lacunæ appears to be sometimes the particular seat of these dilatations. Sometimes the obstacle is foreign to the mucous membrane, and this contracts below only because less fluid passes over it, and keeps it separated; sometimes the contraction primarily occupies this membrane, whether owing to wounds, ulcers, inflammation or any other cause. In either case, as in that in which the fluids take another direction, because an accidental opening gives passage to them, the portion situated below is not obliterated, as has been seen.

The mucous membranes are however capable of contracting adhesions; but for this it is necessary either that the secretion of mucus should be suspended there by inflammation, or that the epidermis, of those which have one, should be destroyed. It is under analogous circumstances that the tongue has been seen to adhere to the corresponding parietes of the mouth, the vagina to disappear by the mutual adhesion of its parietes, the

Fallopian and Eustachian tubes, the nasal and lachrymal ducts, &c. to be obliterated. These adhesions are however much less common here than in the serous system.

The mucous membranes are the seat of thickenings, growths and excrescences, which may be regarded as enlargements of their substance. Polypi are an alteration of this kind; they are divided, as is well known, into many species; many belong as much to the sub-mucous cellular texture as to the mucous membrane itself, which they only raise up; there are some which arise from the periosteum situated in certain places below the mucous membrane, and which are real fibrous bodies; some are formed by a texture which differs more or less from the natural one, and come, in this respect, under the alterations of texture; such are those that are called *cancerous*.

Various organs, that are covered on the interior by mucous membranes, are exposed to defects of situation and figure in which these membranes participate; but the latter have also some which are peculiar to themselves, examples of which are furnished in the various displacements which the mucous membranes of the rectum, vagina, bladder, &c. experience in the prolapsuses, inversions, mucous hernias, &c. of these organs. The internal or villous coat which lines these viscera on the interior then leaves the other coats, and is extended alone to a certain extent, either through a natural opening, or through a preternatural one arising from a separation of the fibres of the nervous coat. The preternatural anuses are almost always complicated with this sort of displacement to which the mucous system is peculiarly disposed from the slight adhesion of its subjacent texture, or *nervous membrane* of the ancients, to the mucous membrane of the organs which it contributes to form.

II. *Alterations in the Organization.*

Inflammation produces in the mucous system, besides the alterations of colour and the vascular development which are peculiar to it, suppurations, false membranes, ulcerations, gangrene, &c. Of all these phenomena, no one is more remarkable than the formation of the false membranes, analogous to what takes place in the serous membranes. The conjunctiva in ophthalmias caused by the vapour of the hydro-chloric acid, the rectum in irritating injections administered to animals, the mucous membrane of the mouth and the pharynx and that of the air tubes in croup exhibit this alteration, in which a soft layer, like the skin of pork, whitish, and slightly adherent, covers more or less uniformly the inflamed mucous membrane. This layer has hardly ever time to be organized; it is thrown out before, or the inflammation is quickly fatal; Albers has found it vascular in croup of a chronic character.

In some cases, inflammation seizes more particularly upon the mucous follicles, which swell and then become very apparent; this variety has been described by Roederer and Wagler. Another form which this affection exhibits, though less evidently than on the skin, is that of *exanthema;* it is observed especially in those parts of this system that are in the neighbourhood of the surface of the body.

The solutions of continuity of the mucous membranes cicatrize like those of the skin; this is what is seen in some ulcers of the mouth and pharynx, after the excision of excrescences from the genital parts, &c. The new texture that is formed is whiter and more resisting than

the first; it sometimes forms filaments which may become troublesome.

In the cases cited, (in vol. 3d, of Bichat,) the mucous system finally experiences the cutaneous transformation as this takes place whenever it is in contact with the external air; its surface is then dried, the mucous fluids cease to lubricate it, the villi disappear, an appearance of epidermis takes their place, and the membrane becomes, in some measure, more stiff. Various parts of this system can also be changed into cartilages; we have cited examples of this when treating of the cartilaginous system.

Cancer is very frequent in the mucous system; it appears under many forms; 1st, it constitutes excrescences similar in appearance to polypi, but very different in their nature; the rectum, the nasal fossæ and the uterus are subject to these tumours. 2d. Other tumours are subjacent to the mucous membrane, which finally partakes of the disease, and ulcerates at their surface; cancers of the stomach, the oesophagus, the intestines and the bladder most often assume this form. 3d. Finally, cancerous ulcers have their primitive seat in the mucous system, begin on its superficies, and arrive, not for a long time, to the deep parts; but little engorgement accompanies them; this variety is common on the lips, the glans penis, and especially on the neck of the uterus.

III. *Alterations in the Development.*

Every organic system may be considered in two ways, as may be seen in the systems previously studied, in relation to the alterations that may take place in its developments; 1st, this development is sometimes irregular in the places where it should take place naturally; hence the defects of conformation, the anatomical varieties and

the anomalies of every kind. 2d. At other times, it takes place preternaturally, where it ought not to take place at all, it invades other systems; hence organic ransformations and productions. The alterations of the first kind are produced by causes that are still but little known, by obstacles which have arrested the natural development at one of its periods, and have thus preserved forms which should be only transitory, by diseases that the fœtus has experienced in the womb of the mother, and perhaps, in some cases, by an original mal-formation of the germ, &c. Those of the second kind take place almost always in diseases; sometimes they are owing to the progress of age. But among the different systems, there are some which appear to be susceptible of one kind of alterations only, or at least to which one kind alone is common, whilst others experience both equally, so that they might in this respect be classed in two orders; 1st, on the one side would be the cellular system, which has so great a tendency to be produced preternaturally and so little to have defects of conformation, and the serous, synovial and fibrous, which are in the same situation; with regard to the nervous, the muscular and the glandular, the reverse is true, this would require a subdivision; 2d, on the other side, the osseous, the arterial, venous, &c. Now the mucous system belongs rather to this last order than to the first.

Its defects of conformation are numerous. All the mucous canals, without excepting the intestines, are subject to deficiencies to a greater or less extent, and sometimes exhibit in their course interruptions the seat of which varies; sometimes it is at their exterior aperture that they are found imperforated; sometimes it is farther in that their cavity is obliterated, either owing to the parietes being confounded together or closed by a sort of

membrane, or because the canal itself has entirely disappeared. These canals are sometimes deficient in a part of their circumference, which then exhibits preternatural openings, fissures and communications; it is in this way that the vagina is seen opening into the rectum; the bladder, destitute of its anterior parietes, communicating with the hypogastric region, which is itself destitute of parietes; the urethra opening into the perineum; the palate establishing a communication between the mouth and the nasal fossæ, the velum pendulum separated in its middle, the lips divided as in hare-lip, &c. These alterations are often only the remains of an unfinished, natural development; this is evident in the hare-lip, the extroversion of the bladder, &c.

We should not forget, in the anomalies of development of the mucous system, the *digitiform* elongations or digital appendices of the intestine. These elongations are formed by all its membranes; we have seen above the attempt that has been made to explain the mechanism of their formation. There is sometimes found, towards the point of junction of the pharynx and the oesophagus, similar appendices which retain the aliments, which occasions a sort of rumination; these appear to be consecutive and formed by a hernia of the mucous membrane across the fibres of the nervous coat. Calculi of the bladder are often lodged in cavities produced by the same mechanism.

We may consider as preternatural mucous membranes, 1st, the membrane which lines the interior of abscesses; 2d, that of old fistulous canals.

The membrane of abscesses, though belonging to cavities closed on all sides, has in fact more points of resemblance to the mucous than to the serous membranes; follicles, it is true, have not been described in it; but its

surface is soft, pulpy and fungous, like that of the mucous membranes; when put in water. it seems, like these last, to be covered with filaments. The analogy of secretion is an additional reason in favour of this resemblance; what is more analogous to mucus than pus?

The resemblance is still more evident in sinuses and fistulas terminating on the exterior. Hunter had already noticed this resemblance, upon which Bayle, Laennec and others have more particularly insisted. The membrane of the fistulous canals has a distinct epidermis in the neighbourhood of the skin; farther in, it disappears, and the membrane becomes red, soft and fungous; it would be difficult, in this place, to distinguish it from a portion of mucous membrane taken from the sinuses, for example; it has no follicles, but its fluid is almost of the same nature; below it, the cellular texture is often hardened and more compact than in the natural state, as is seen in callosities; it is a result of inflammation; this texture is sound when the inflammation is slight. When every thing ceases to pass through the fistula, it contracts and its canal closes; it differs in this from the mucous ducts, which are not obliterated under the same circumstances; but its obliteration is not always easy, especially in the neighbourhood of the skin, and in general fistulous canals have but little tendency to cicatrization; thus we endeavour by every method to develop inflammation in them or to destroy the membrane which covers them.

In abscesses, as in fistulas, the preternatural membrane derives its origin from the cellular texture, and is owing probably to an albuminous exudation of the nature of that which constitutes false membranes.

ADDITIONS

TO THE

SEROUS SYSTEM.

MORBID ANATOMY OF THE SEROUS SYSTEM.

The alterations of this system have been already in part pointed out by Bichat; the following is what we shall add to what he has said of them.

I. *Alterations in the External Forms.*

Sometimes the serous membranes thicken at the same time that they are increased in extent, as is seen especially in hernias and dropsies; this increase in all directions supposes a real increase of nutrition in them; this cause then should be added to all those which facilitate the extension of these membranes, as their displacement,

the disappearance of their folds and their peculiar extensibility. (See in the Serous System the article *Extensibility.*) In other cases, the thickness of these membranes is so much diminished by distension, that oftentimes they are found with difficulty. This is not rare in umbilical hernia.

The serous system is subject to various displacements, which alter more or less its configuration. These displacements are most often only secondary, and are owing to changes that take place in the viscera which this system covers, or in the parietes of the cavities which contain these viscera, parietes upon which it is also spread; they are consequently of the same nature as those which the various functions produce in the natural order. Now these displacements take place in three ways; 1st, the serous membrane leaves the parietes and goes upon the viscera; 2d, it leaves these last to go upon the first; 3d, it extends without the parietes, forms a sac, which is united to the general sac that it forms within; this sac is constituted by the portion that lines the parietes; but in time the membrane is also detached from the viscera, or draws them out when it adheres to them too strongly. The sac of which we are speaking is produced whenever a viscus, forced through the parietes of its cavity, carries at the same time before it the serous covering of these parietes; this is the sac of hernias, the *hernial sac* properly so called. But in some cases, this sac exists previous to the hernia, and the viscera are not connected with it till afterwards; this is what takes place when fat accumulates on the exterior of the peritoneum for example, and finally forms a mass, the situation and weight of which draw it outwards, and which also draws the serous membrane with it, so that this forms a sac ready to receive the viscera on the first

occasion; an arrangement very improperly known by the name of *fatty hernia*. It is important to know in practice the displacements of the serous membranes, because they often change the relation of the parts; the sac of hernias, in particular, presents many points for study.

II. *Alterations in the Organization.*

The most of those which are the consequence of inflammation depend on changes which are experienced by the fluids that are naturally exhaled in the serous cavities, changes which vary according as the inflammation is acute or chronic. These fluids may be simply increased in quantity, and preserve all the qualities of the serous fluids, or they may be altered in various ways; from this simple serum to opake pus, destitute of globules like that of the cellular texture, there is an infinity of gradations. Most often a matter capable of concretion is produced, either albuminous flakes swim in the effused fluid, or a layer of the same nature, *a false membrane*, distinct from this fluid, covers the inflamed serous membrane, or this layer, interposed between the two folds of the serous membrane not separated by an intermediate fluid, establishes between them an adhesion, soft and glutinous, similar to what is formed between the lips of a wound united by the first intention. The false membranes begin by insulated points of albuminous matter, deposited at first only in the most inflamed places, afterwards united together, and then forming a continuous layer, the thickness and consistence of which vary. This layer adheres but slightly to the membrane which furnished it; but there is observed, when it is detached from it, that a sort of indentations, reciprocal inequalities unite one to the other; under it, the serous membrane is usually

red and penetrated with vessels. From the production of these false membranes, and from the soft and skin-like adhesion which is but a slight modification of them since it only differs from them by the absence of a fluid suitable to maintain the separation of the folds of the serous membrane, are derived all secondary effects of inflammation, both acute and chronic, all the varieties of thickening and all the modes of adhesion. The albuminous or skin-like matter of the false membranes, which thickens, hardens, is organized and penetrated with vessels, occasions these varieties, by the variable forms it assumes at the moment it experiences these changes; we shall not revert to the manner in which they take place; the development of the vessels, which is the main point, has been examined in the capillary system. We may now understand how miliary granulations, opake, whitish, sometimes extensive and supported by a narrow pedicle, cover the serous membranes after their inflammation, the evident result of the concretion of albumen on their surface; how layers of the same nature are seen, under the same circumstances, upon the pericardium, the arachnoides, the tunica vaginalis, &c.; how these different membranes, the pleura and peritoneum in particular, often acquire in chronic inflammation, a thickness double or treble that which they before exhibited; a thickness which is only owing to the presence of the false membranes organized and intimately united with these membranes, and which should be distinguished from that which is owing to a real increase of nutrition; how the cellular and filamentary adhesions arise, those in which the two folds of the membrane are entirely confounded, and the filaments, &c. according as the albuminous matter is stretched a little or not at all, or as on the contrary, this matter has been subjected by the motions of the part

to frequent distensions, according as the inflammation has continued for a longer or shorter time and the organization has been more or less perfect, &c. &c.

A cicatrix arises from the serous system when divided, though it was doubted for a long time. It is linear and afterwards imperceptible when the edges of the wound have remained in contact, and it is a cellular membrane analogous to the texture whose place it supplies when these edges have not been properly brought together; we may be convinced of this fact by examining the pleura of an animal which had been opened some time before. Thus, in the hernias which succeed to the old wounds that penetrate the abdomen, the peritoneum forms, as usual, a sac for the displaced viscera, though the contrary has been for a long time maintained; only this sac is more delicate and seems to be entirely formed by the cicatrix which remains more extensible than the neighbouring texture.

The serous membranes are ossified; no one is exempt from this alteration, which appears under many forms. They are usually plates appearing rather to raise up the membrane than to belong to it; sometimes, however, these plates are almost naked on the interior of this membrane. The tunica vaginalis, the pleura and the peritoneum contain also, in some cases, a species of concretions similar to those of which the synovial system is the seat, and to which we shall revert.

M. Laennec has described, in his treatise upon *Auscultation Médiate,* tumours of the pleura which he refers to the cerebriform cancer; they occupy the internal face of this membrane, to which they adhere strongly; their environs are marked by a slight redness owing to the development of the blood vessels; they are usually in small number. There is often found, in intestinal ulcerations, particularly those which take place

in phthisical patients, small miliary tubercles which make a part of the serous membrane at the place of these ulcerations. Various authors have spoken of schirri of the serous membranes; but they no doubt intended to designate by this name thickenings, the result of inflammation, and not a true degeneration.

III. *Alterations in the Development.*

The defects of conformation are quite rare in the system of which we are treating. The peritoneum, the pleura and the pericardium, instead of representing a sac without an opening, are sometimes open in front, and are destitute of the exterior lamina to a certain extent, so that their viscera are bare. The arachnoides has a very imperfect organization in the aencephalous fœtuses; but this defect is but a consequence of that which then exists in the brain. The peritoneum has exhibited, in some rare cases, a sort of vesicle or secondary sac situated in its interior, communicating with it by a narrow opening and containing a part of the abdominal viscera.

Bichat was the first who satisfactorily proved the analogy which exists between the cysts that are preturnaturally formed in various parts of the body and the serous membranes. (See the *Cellular System*, Vol. 1st, and the *Serous System*, Vol. 3d.) He has refuted the opinion of Louis upon the mode of origin of these cysts, which he regards as always existing prior to the substances they contain. It is necessary however to make a distinction here; in fact, 1st, there are cysts that are really preexistent, as all those that are called *meliceris*, *atheroma* and *steatoma;* but these are only sebaceous follicles

exceedingly dilated, as we shall see in another place; (Vide the *Dermoid System*;) the cysts of the ovarium are perhaps also in the same situation, as they appear to be owing only to preexisting vesicles; 2d, there are evidently consecutive ones, which are formed around various bodies coming from without, around the blood in apoplexy and pus in chronic abscesses; 3d, the origin of a great number is obscure, to which the observations offered by Bichat apply perfectly.

On the other hand, the organization of cysts is far from being the same, though in general they belong to the serous system. Some are soft and almost fluid, as it were; it seems as if they were the result of a simple exudation; some of this species have been found in the brain. At other times it is a membrane but little different from the cellular texture; in some cases, on the contrary, it is a real serous cavity, very distinct from this texture, as is seen on the neck, and in the spermatic cord. There are some, the structure of which resembles that of the mucous membranes; others have a slight resemblance to the skin. These cysts are moreover susceptible of various transformations; they become fibrous, cartilaginous and osseous; the cancerous and other degenerations are also met with in them.

The substances contained in these preternatural sacs are infinitely various. Solid, foreign bodies, blood, limpid serum, viscid, gelatinous or mucous matter, serous fluids mixed with albumen that is capable of concretion and that which is not, fatty fluid matters, or those with different degrees of consistence, a pultaceous, stony or cretaceous substance, and concretions more or less hard may be contained in them. Authors have been much engaged in explaining these differences, which are often observed in cysts that are analogous in structure. They

have been in general attributed to causes purely mechanical. It is thus that Bostock, who has examined the matter of many cysts found in the interior of the pelvis, after having praised Cullen for rejecting these explanations, proposes himself one of this kind, by which, according to the state of the heart and the modifications which result from it in its action, according to those which the animal heat experiences or the disposition of the small vessels, there would pass through these last, sometimes the serum of the blood almost pure, sometimes this serum, with a proportion of albumen, either in a fluid or concrete state, sometimes these two matters united to fatty matters under various forms, and all the substances in fact which are found in cysts. It is evident that the mechanism of exhalations is too little known, for these explanations to be accurate; the causes mentioned may no doubt contribute to the production of the phenomenon, but they assuredly do not alone constitute it.

Hydatids resemble cysts in their apparent structure, though they are very different in their nature; this is so true that authors are not often agreed upon what should be called *cyst* and what *hydatid*. The following however are the principal characters by means of which they are distinguished; 1st, cysts are attached to the surrounding parts by cellular texture and blood vessels; hydatids, on the contrary, are perfectly free; it is true, that in some cases cysts are found hardly adherent; but these cases are rare. 2d. The parietes of the cyst have always more or less consistence; the hydatid has only that of the white of an egg boiled. 3d. The hydatid often exhibits in some point of its surface, something like little grains which are discoverable by the naked eye or with a glass, and which seem to be the rudiments of other hydatids; nothing similar is seen in cysts. Notwithstanding these

differences, which are striking, there are cases where it is difficult to decide, to which kind of productions they belong; this is almost always the case, for example, in the vesicles of the plexus choroides, and still more in the masses of the same kind which are situated in the placenta, and the nature of which is still very doubtful.

ADDITIONS

TO THE

SYNOVIAL SYSTEM.

Of the Synovial Membranes.

Page 179.—" From these different considerations we may be easily convinced, I think, that notwithstanding the adhesion of the synovial membrane at different points, it should be considered . . . as a real sac without an opening, everywhere continuous and spread upon all the organs of the articulation."

The reality of this arrangement, already recognized by Nesbith, Bonn and Hunter, and which some persons have doubted, is also proved by the following considerations.

1st. In inflammation of the synovial membrane, the redness, beginning on the free portion of this membrane, extends gradually from the side of the cartilage, the surface of which it finally reaches, nearly as in ophthalmia, the conjunctiva reddens gradually upon the globe of the eye, according as it is near the centre of the cornea. This gradation is easily observed in dogs, in an articulation that is opened, and the interior of which is left in contact with the air. The redness, in this experiment, never reaches the substance of the cartilage; it is confined to its surface, and is, as it were, foreign to it.

2d. There is a continuity of vessels between the kind of capsule which the membrane forms around the osseous surfaces, and the surface of the cartilage, as is evidently seen in the preceding experiment. The synovial membrane of the knee, injected in this way, exhibits, in its adipose ligament, vessels which extend directly in its portion which covers its cartilage, to the two extremities of this ligament.

3d. If a bone be divided perpendicularly at its articular extremity, by leaving untouched the cartilage of this extremity, and if, by the separation of the two halves of the bone, the cartilage be afterwards ruptured, the two fragments still hold together by the synovial membrane which passes from one to the other. It is the same when the surface of a cartilage is broken, and the piece raised up, so as to break it at its base; this piece still adheres by means of the synovial membrane, which has not been ruptured.

Let us conclude from these different facts, that the synovial membranes, far from being limited to the circumference of the articulations, go to the whole extent of the osseous surfaces, upon the cartilages which cover these

surfaces, and really constitute sacs without an opening, in every respect similar to those of the serous membranes, as has been very well seen by Bichat.

Synovial Fringes.

Page 181.—" If a remarkable redness sometimes distinguishes these bunches" (the pretended glands of Havers) " from the cellular texture, it is because the vessels are more concentrated and nearer together in them. This redness of some pretended synovial glands, the only character that distinguishes them, is then as it were merely accidental; it no more indicates their glandular nature, than it proves it in the pia-mater, in which it is owing to the same cause."

What is here said of the fatty bunches so improperly called *glands of Havers*, may be also said of the synovial fringes which surmount these bunches, and the vascular structure of which does not prove that they are excretory ducts. These fringes, very well described and drawn by Monro, are folds of the synovial membrane floating in the articulation, and precisely analogous, in this respect, to the epiploons of the serous membranes, and the epiploic appendices of the intestines. These folds are grooved on their surface, have their free edge cut in various ways, as can be very well seen by floating them in water, and resemble in some measure fringes; hence the name that has been given to them, and which may be retained, though it by no means expresses their nature. Between the two laminæ of these folds, and in these laminæ themselves, there is a great number of vessels, arteries, veins, exhalants, and no doubt absorbents also; thus the synovial membrane is much redder there than

any where else. It is to the presence of these vessels, the exhalants in particular, that the following phenomenon is owing, which may have deceived Havers; if these folds are pressed, synovia oozes out of them, which evidently comes from the open exhalant orifices, and not from particular ducts.

All the synovial membranes have these elongations, both those which belong to the tendons and those destined to the articulations, although they are more evident in the last than in the first; among these, those in the form of vesicles have them more constantly than those in the form of sheaths. The great articulations, as those of the knee and the hip, contain the largest; in the small ones they are often only reddish points slightly prominent. They are in general situated near the place where the synovial membrane is reflected around the articular cartilage, and usually correspond to the adipose texture of the synovial bunches, in part contained in their substance; those of the tendinous synovial membranes have often between their laminæ, instead of this texture, soft bodies like gelatine, the fatty bunches analogous to the articular ones called *glands of Havers* being wanting in many of these membranes.

The synovial fringes, from the great number of vessels they contain, are the especial seat of the secretion of synovia. This secretion is perspiratory, and evidently of the class of exhalations; it only takes place there more than in any other point of the membrane, because the exhalants are more numerous there.

The following is the idea that should be formed of synovial fringes and bunches; 1st, blood vessels surrounded with a more or less abundant adipose and cellular texture; 2d, folds, which embrace them and in which they particularly terminate; folds more or less

numerous, more or less extensive, and whose surface pours out synovia in abundance.

The mucous system exhibits something analogous to the fringes of the synovial membranes in the folds which exist under the tongue, and upon the sides of the frenum of this organ; these folds are real secretory fringes, designed to increase the extent of the exhalant system.

Parallel between the Synovial Membranes and the Serous ones properly so called.

Page 181.—" Though the synovial membrane is very analogous to the serous surfaces, it must however exhibit differences of texture, since the fluid it exhales is a little different. Its texture has not the suppleness of theirs. It resists maceration longer."

The synovial membranes might justly be called the *serous membranes* of the articulations and the tendons, yet the difference of the parts which they invest gives them peculiar characters. Most of these characters have been stated; the following are some more of them.

The synovial membranes receive fewer sanguineous and other vessels, than the serous membranes. These appear, as it were, to be entirely formed of vessels in inflammation, after fine injections, &c.; the synovial membranes contain much fewer under like circumstances. Compare the deep tinge of the serous membranes in asphyxia with the much less evident one of the synovial membranes in the same case, and you will be struck with this difference. The lymphatics are in immense quantity in the serous membranes, as is shown by injections; we admit them from analogy, and only on account of their functions, in the synovial membranes.

Maceration discovers in these distinct laminæ and fibres ; the serous membranes have them also, but theirs are much less apparent.

The synovial membranes, especially those of the articulations, are less extensible, and seem to be torn sooner than the serous ones ; at least ruptures are more frequent in them than in the latter. This difference is owing perhaps solely, or in great measure, to this, that the connexions of the membranes are not the same, any more than the causes which distend them ; the one fixed to the bones, and strongly drawn by these organs, must yield and break, as happens in luxations, the others, in relation with the soft parts and capable of yielding themselves, are merely elongated, as is seen in hernias.

Existence, Forms, Organization, &c. of the Synovial System of the Tendons.

Page 191.—" There are many synovial membranes the existence of which is variable ; such as, for example, that of the great glutæus, in the place of which there is often found only a cellular mass."

In this respect, viz. that some parts of this system are sometimes wanting and are then replaced by cellular texture, the synovial system of the tendons is confounded, more perhaps than the serous and the articular synovial, with the cellular. But, besides the latter resembles in many places, in its arrangement, the mucous bursæ or synovial membranes of the tendons. Wherever great motions take place, the cellular texture is loose, lamellated and filled with fluids ; its laminæ are separated by broad interstices, imitating more or less exactly the cavity of the serous or synovial membranes, so that it may

truly be said, that these membranes exist in rudiment wherever there is this kind of motions. This is what is seen on the thigh, between the tendon of the anterior rectus and that of the triceps, between the biceps and the anterior brachialis on the arm, &c. There is a sort of gradation according to the mobility of the parts, in this arrangement of the cellular texture; the integuments of the back of the hand, those which cover the anterior face of the patella, the olecranon and acromion have under them, on account of their frequent sliding, a cellular texture which resembles that which is found around the tendons, sometimes even true mucous bursæ. Finally, where the frictions are very evident, as between the tendons and the bones, these are nearly constant. They are found almost uniformly, with a greater or less degree of development, between the skin and the bones, in the places where these parts have frequent motions, as at the elbow and the knee, so that in those places there are generally sub-cutaneous mucous bursæ, as there are tendinous ones.

There is a circumstance which may also have an influence upon the existence and number of the tendinous synovial membranes; it is that some are sometimes insulated, and sometimes confounded, as is seen in those which line the sheaths of the tendons, according as these sheaths are themselves separated or confounded together.

In order to see these membranes well when they exist, we raise the tendon below which they are to be found, open them to a small extent, and force into this opening air or the matter of injection; they are distended and then become very apparent, and distinct from the surrounding cellular texture; or we may be content with opening them with care; the moisture and polish of their surface serve to distinguish them.

The tendinous synovial membranes exhibit some differences in their forms, besides the general division into *vesicular* and *vaginal* pointed out above. Their cavity, instead of being simple, is often *multilocular*, (having many cells,) divided by elongations which are detached from their interior ; these elongations are usually soft, but in some cases fibrous. The vaginal mucous bursæ have one of their extremities divided in the manner of digitations, when many tendons, united at first in a single sheath, are afterwards separated, &c.

These membranes have, as we have said, fringes and sometimes even synovial bunches on their interior. Fourcroy and Koch have seen villi in them. The vesicular synovial membranes are of a texture more dense and compact than the vaginal, and nearly fibrous in some points.

Their fluid is yellowish, sometimes reddish ; but then this tinge is accidental, and generally a result of the transudation which takes place after death. It appears to be thinner in the synovial membranes of small extent, and which do not experience considerable frictions ; thicker and more viscid in the others, in that which covers the great trochanter, for example, and whose motions are very evident. This fluid has not been analyzed ; it appears to be formed of water, albumen, soda and perhaps some salts ; it is miscible with water in any proportion ; heat and the acids coagulate it ; it turns the syrup of violets green ; when dried, it is transformed into a kind of horny lamina, very thin, which burns like the dried white of an egg.

The mucous bursæ are very extensible, as is seen when they are inflated ; dropsy also furnishes a proof of it. They contract when the distension is removed.

MORBID ANATOMY OF THE SYNOVIAL SYSTEM.

I. *Alterations in the External Forms.*

The distension of the articular synovial membranes by a collection of synovia constitutes *hydarthrosis*, an affection that is not common and which is observed especially in the knee, which, in general, presents the most frequent examples of all the diseases of the articulations. The quantity of the accumulated fluid varies, as well as the nature of this fluid; this is dependant on the various complications that may exist, as on inflammation in particular. The distension is usually more evident in one or several points, where the synovial membrane is the least supported by the surrounding parts.

Dropsy of the mucous bursæ is called *hygroma* when its fluid is serous, colourless and limpid, and *ganglion* when it is a reddish, thick and viscid matter, more or less similar to currant jelly. Neither always have their seat in the natural mucous bursæ; they are sometimes preternatural tumours, a sort of cysts. It is thus that the ganglions are formed upon the back of the hand though there are no mucous bursæ in this place. The hygroma is frequent in front of the patella, on the shoulder and the elbow, places where the cellular texture is so closely connected with the synovial membranes; it takes place especially in persons who have these parts subjected to constant pressure.

Anchylosis exhibits, as is known, many varieties. In that which is called *false* and which should be considered a distinct disease, all the parts which enter into the composition of the articulation are thickened. But anchylosis

properly so called, affects especially the synovial membrane. Sometimes filaments of various extent and consistence traverse the articulation, and unite the two opposite laminæ of this membrane which covers the articular surfaces ; a sort of amphiarthrosis then exists ; an articulation with limited motion and with continuous surfaces takes the place of the one which existed before with great motion and contiguous surfaces ; it is to this first variety that the name of *false anchylosis* may be given, if it be desirable to preserve this distinction. Sometimes the adhesion between the two surfaces is intimate, the synovial membrane disappears or is changed into cellular texture, the bones are united together and are finally deprived of the lamina of compact substance which covered their extremity ; this is *true anchylosis*. These two kinds of adhesion suppose here, as in the preceding system, an anterior inflammation.

II. *Alterations in the Organization.*

Besides these adhesions, the inflammation of the synovial membranes sometimes produces ulceration in them, though it is quite rare ; Mr. Brodie has related two examples of it. In other cases, this inflammation terminates by resolution, and there results from it only a little stiffness and embarrassment in the motions, owing to the thickening of the parts. It may also be followed by suppuration and effusions of various kinds, though these effusions are observed less frequently than in the serous system.

The tendinous synovial membranes exhibit in their inflammation, fortunately quite rare, the two modes of adhesion which have been noticed, viz. filaments and

adhesions properly so called. They also suppurate at other times, and then their tendons most usually exfoliate.

The foreign bodies of the articulations, which some have taken for concretions formed in their interior, and which others consider as broken and detached portions of bone or cartilage, are always situated in the beginning, without the synovial membrane. They are osseous or cartilaginous productions deposited at first in the cellular texture, pushed afterwards by degrees, either by the various motions or any other cause, into the cavity of this membrane, in which they are enveloped and which they stretch prodigiously as they advance; it terminates by forming for them only a sort of pedicle, which at length becomes thin and finally breaks; when this rupture takes place, the body is loose in the articular cavity. The state which it then exhibits varies; its consistence is sometimes very soft and like albumen, at others cartilaginous or osseous; in some cases the same body exhibits these different states. The long continuance of these bodies and the pressure which they exert, often produce upon the articular cartilage, depressions or cavities in which they are lodged; these depressions have led to the belief that there was a loss of substance of the cartilage, the detached fragment of which produced the foreign body; but we cannot conceive of any cause capable of producing such a separation, and besides, inspection does not confirm this idea.

Bodies of another nature are developed in the mucous bursæ, and sometimes also in the articular synovial membranes. They are usually extremely numerous, of the size of a large apple seed, flattened in various directions and of a whitish colour. They have been thought to be animated, but they appear to be inorganic; their origin is but little known. Monro has also found in the

mucous bursæ small bodies of a peculiar nature. The same author says that he has met with cartilaginous plates in them.

In *white swellings*, an improper term under which is confounded various degenerations and the chronic inflammation of the synovial membrane, this often becomes the seat of a peculiar degeneration ; its texture becomes thickened, greyish, like lard, homogeneous and surrounded with soft fungi, the presence of which beneath the integuments may lead to the belief that there is an abscess on account of a kind of obscure fluctuation that is thought to be felt there.

III. *Alterations in the Development.*

The membranes analogous to the synovial ones that are met with in the supplementary articulations, the consequence of luxations not reduced, are in part formed by the remains of the old one that is ruptured and in part by the real production of a new texture. Fractures that have not united sometimes have a capsule which seems also to belong to the synovial system, inasmuch as it contains a serous fluid, as we have said elsewhere.

The synovial cysts, which were mentioned at the beginning of this article, are preternatural mucous bursæ.

The absence of some tendinous synovial membranes, under some circumstances, is the only defect of conformation peculiar to this system.

ADDITIONS

TO THE

GLANDULAR SYSTEM.

Intimate Structure of the Glands.

Page 200.—"The glands, like all the other organs, . . . have their peculiar texture which especially characterizes them, which belongs only to them, a texture in which the arteries communicate with the veins and the excretories. Let us not push our researches further; if we do, we shall be inevitably entangled in conjectures."

Is the communication direct between the arteries and the excretory ducts, or is there something intermediate between these two orders of vessels? The results obtained by Ruysh and Malpighi in the solution of this question, though opposed to each other, are however equally

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founded upon facts rather than upon mere conjectures. Only these two anatomists, both alike commendable, no doubt directed their attention to glands wholly different. In fact, it is easy to see, by the description even of the glandular system, that the organs which are comprised in it, even by restricting as much as possible the term *glands*, and by applying it only to those to which it exclusively belongs, by taking from it consequently the mucous and sebaceous follicles or glands, of which we have spoken in the article on the *Mucous System*, and the glandiform organs, as the thymus, the thyroid, the supra-renal capsules, &c.; it is easy to see, I say, that these organs vary in their most essential properties, and have at most only some general points in which they approximate each other. Thus, as it regards structure, of which we are now to treat, the opinion of Ruysh seems to be perfectly applicable to some of these glands, the liver, the testicles and the kidneys; whilst, in respect to others, such as the lobulated or conglomerated glands in general, that of Malpighi has more probability in its favour. Inspection and experiment may be resorted to; the one shows us, in the first of these glands, an evident vascular arrangement in all the points of the organ, a continuity that can be traced by the eye, if we may so say, between the sanguineous ramifications and those of the excretories; in the second, this arrangement is much less distinct and it is impossible to discover the continuity in most cases. By the other we see, in injections, the rapid, easy and constant passage, in the excretory vessels, of the matter driven in through the arteries in one class, the liver, kidneys, &c.; this same passage, slow, difficult and oftentimes wanting in the others, as in the salivary and lachrymal glands, pancreas, &c. It may then be possible that the little grains that are perceived in the latter may

be small bodies intermediate between the arteries, veins and excretories, as Malpighi thought, species of follicles in which the one terminate and from which the others go off; whilst every thing may be vascular, according to the hypothesis of Ruysh, in the glands of the other kind. Hence no doubt why the bloody excretions are very much more frequent in the latter, especially in the kidney, than in the first.

Influence of Nerves upon the Action of the Glands.

Page 223.—" If we weigh the proofs given by Bordeu of the influence of the nerves on secretions, we shall see, that they either rest upon false facts, like those of the section of the nerve, of sleep, &c. or upon vague data."

Every thing which relates to the peculiar action of the glands is in general but very little known, as is the case with all the phenomena which take place in the interior of the organs. All that is known upon those of glandular secretion is confined nearly to this; blood containing the materials of secretion arrives in the glands by the arteries, except in the liver, which receives it from the veins and the arteries; this blood, in traversing the glands, undergoes changes in them in consequence of which a fluid wholly different from it is produced. But do these changes take place suddenly, or slowly and as the blood advances in its course, and what is their nature? Are they merely the result of the configuration of the parts and a phenomenon purely mechanical? Is it a chemical or galvanic action which produces them, a doctrine which seems to prevail at the present day in many schools? Is it a consequence of the nervous influence, or finally do

all these causes contribute to it at once? This is what we are ignorant of.

As to this last influence, that of the nerves in secretions, it is probable that it exists, as Bichat says, though it may be very difficult to be certain of it directly. The division of all the nerves of a gland, suggested by Bordeu, is almost everywhere impracticable. The experiments related by Bichat will no doubt be found far from being conclusive The following, which are perhaps scarcely any more so, but in which however the results seem to be a little more decisive, and which besides appear to be so much the more remarkable, as they are in evident contradiction to the first, are made by Mr. Brodie.

1st. The brain having been removed, respiration being supported artificially, that the circulation might not stop and that the animal might continue to live, the urine was no longer secreted. This fact does not prove positively, it is true, that the cerebral action has an influence upon the function which the kidney has of secreting urine; for it might be that the circulation was weakened in this case so as to render the secretion less active; it is however a strong presumptive evidence of this influence.

2d. In order to be able to appreciate the mode of influence of the nerves of the eighth pair upon the mucous secretion of the internal coat of the stomach, a secretion not sufficiently abundant in the natural state to enable us to obtain striking results, it has been attempted to increase the products of it by giving to an animal arsenic and other poisonous substances of the class of corrosive poisons, which produce, among other phenomena, an accumulation of the mucous and other fluids that are constantly poured out on the internal coat of the stomach; the nerves of the eighth pair have afterwards been divided. At the death of the animal, that mass of fluids is

not found, which is never wanting under any other circumstance. It seems to follow from this that the integrity of these nerves is necessary to enable the mucous glands or follicles of the stomach to answer to the stimuli which are directly applied to them.

MORBID ANATOMY OF THE GLANDULAR SYSTEM.

The extreme diversity that exists in this system makes it almost impossible to describe in a general manner the morbid alterations of the glands; there are too many peculiarities belonging to the descriptive anatomy, and too few common points; it would require almost as many divisions as there are organs comprehended under the name of *glands;* it is the same with regard to the description of this texture considered in the natural state: what we shall now say will be a proof of it.

I. *Alterations in the External Forms.*

Increase of size as well as the circumstances under which it takes place, have been noticed (*Bichat, vol. 3d,*) in the glands that are in pairs; the glands that are not in pairs, like the liver, rarely experience it, without it is joined with an alteration of texture.

Atrophy comes on in two ways, viz. 1st, from compression, as from an external pressure long continued, or when a tumour has gradually destroyed the interior of an organ; 2d, from want of exercise, as takes place in certain glands from the progress of age.

We know all the varieties of consistence, and all the differences of colour which the liver exhibits in diseases. The testicle and the kidney also present some of them; the other glands are much less subject to this kind of alteration.

Displacements are observed in those of these organs situated in the abdominal cavity, some of them, as the spleen, can be drawn from their place in hernias.

II. *Alterations in the Organization.*

Inflammation of the glands affects those rather with a dense and compact texture, than the granulated ones; yet the breast is particularly disposed to it. Besides, it is necessary to distinguish this inflammation from that of the cellular texture and the neighbouring lymphatic glands, this is important especially with regard to the parotid, which is often thought to be inflamed, whilst its texture is sound and the cellular texture which surrounds it is alone affected. This inflammation rarely terminates in gangrene; on the contrary, suppuration and induration are the frequent consequences of it.

Some glands, placed on the exterior, when comprehended in wounds, become the base of a cellular cicatrix; but the glandular texture is not reproduced.

The extreme frequency of transformations of every kind, in the system of which we are treating, has already arrested the attention of Bichat. (Vol. 3d.) Yet it is still necessary to establish a distinction in this respect; in fact, 1st, most of these transformations have been observed in the liver, the kidney, the testicle and the mamma, whether they are formed of textures analogous to those which exist in a natural state, or whether textures wholly foreign to the economy, except in a state of disease, con-

stitute them ; 2d, who does not know, on the contrary, how rare they are in the lachrymal and salivary glands, and even, to a certain extent, in the pancreas?

III. *Alterations in the Development.*

Notwithstanding the numerous irregularities in the forms of the glands, we must not however take literally what has been said (Vol. 3d.) of the frequency of these irregularities, compared with their rareness in the organs of animal life. The difference is by no means so striking as Bichat has pretended ; we have seen elsewhere that the brain has not always precisely the same conformation in its two hemispheres, and that Bichat was himself a proof of it ; his cranium exhibited in fact this singularity, that the forehead was much more prominent on the right than on the left, and that an opposite arrangement existed at the occiput, whence there resulted an inequality of size, at the right and the left, in the anterior and posterior lobes of the brain. The bones, muscles and nerves exhibit analogous varieties. On the other hand, the glands are by no means so variable that this would furnish a character sufficient to distinguish them from the preceding organs. Their varieties are often insignificant; as in a bone, a groove, a vascular foramen or a depression for a tendon have not always precisely the same position, extent and direction ; so in a muscle, the length of the fleshy fibres, the extent of the tendon, the situation and number of the intersections, &c. vary ad infinitum, and it is of but little consequence in a gland, whether a lobe be a little larger, an edge more or less hollowed out, an extremity more or less extended, &c.

Besides, the glandular forms are more or less constant according to the organs in which they are examined,

The kidney alone exhibits almost as many varieties as all the other glands together ; sometimes by itself or united to that of the opposite side, sometimes divided as in the fœtus into many lobes, sometimes situated in the pelvis or in front of the vertebral column, there are but few subjects in which it is perfectly similar. The liver, the salivary and lachrymal glands, &c. exhibit less of these differences.

The glandular texture is never preternaturally produced.

ADDITIONS

TO THE

DERMOID SYSTEM.

Colouring Matter.—Mucous Body.—Papillæ.

Page 273.—" It is necessary to distinguish two portions in the capillary system exterior to the chorion. 1st. One is constantly filled with the colouring substance of the skin. 2d. The second is constantly pervaded by many fluids. These two portions are entirely independent, and have probably no kind of communication."

The colouring matter of the skin forms, in the negro, a layer distinct, not only from the chorion and the epidermis, in which Riolan thought it placed, but also from the other parts of the mucous body, with which Malpighi confounded it. This matter exists also, though less apparent, in the whites who, without it, would not differ from

albinos, who are entirely destitute of it. The mucous body, which Malpighi regarded as a mere coat, a sort of varnish covering the papillæ, a varnish for which Bichat has substituted a reticular body, essentially formed of vessels, and divided into two portions independent of each other, appears in fact to contain many distinct parts observed in the skin of the negro by M. Gaultier, and in that of quadrupeds by M. Dutrochet.

If the skin of the heel of a negro be cut, a little obliquely as to the substance and transversely to the direction of the lines which the papillæ represent, there is distinguished upon the divided edge the following objects; 1st, immediately above the papillæ, and making a part of them, there is found a series of small vascular fasciculi, designated by M. Gaultier by the name of *sanguineous bunches.* 2d. Between these bunches and the epidermis, is seen a black undulating line, placed between two white lines, one of which separates it from the first layer, and forms the *deep-seated, whitish layer,* composed, according to M. Gaultier, of white vessels. 3d. The black line which is above, or the coloured layer, takes the name of *gemmule,* on account of its undulations, which make it appear as if composed of an infinity of small concave bodies embracing the summit of the papillæ; each of these small bodies receives two sanguineous bunches, the summit of the papillæ being bifurcated, as we shall say hereafter. 4th. Finally, immediately below the epidermis is the second colourless layer, or the *superficial whitish layer,* formed of serous vessels like the first.

There are then, according to this, four parts in the mucous body, and by adding the two white layers to the two portions admitted by Bichat, and which might then be regarded as real insulated layers, we should have the

true structure of this body. But among these layers, the first, formed by the sanguineous bunches, does not really belong to the mucous body; it is nothing else than the termination of the vessels ramified in the papillæ, and forms a part of what was formerly called the *papillary body;* so that the number of layers which constitute the mucous body may be reduced to three; this is what M. Dutrochet has done in the analysis he has given of the structure of the skin of quadrupeds. He has recognized the existence of these layers, such as M. Gaultier has described them; only he has designated them in the following manner; the skin is composed according to him, 1st, of the dermis; 2d, of the papillæ; 3d, of the epidermoid membrane of the papillæ, which is the *deep-seated whitish layer* of M. Gaultier; 4th, of a coloured layer; 5th, of a horny layer, which answers to the *superficial whitish layer;* 6th, of epidermis.

The existence of a mucous body between the dermis and epidermis, composed of at least three layers superadded to each other, seems to be demonstrated by the results which we have just stated; yet all anatomists do not admit this existence. According to M. Chaussier, the skin has but two distinct parts, the dermis and the epidermis; the one containing all the organic elements of this membrane, without the possibility of establishing the boundary between these elements, the other being the inorganic or non-vital portion of it. Haller, Camper, Blumenbach, &c. were inclined to reject the mucous body in the skin of the white, and to admit its existence only in that of the negro.

When the epidermis is removed by maceration from a portion of very black skin, from that of the scrotum of the negro, for example, the colouring matter remains in part upon the dermis and in part upon the epidermis,

more however upon the latter; but if the maceration be continued, this matter is detached from both, and deposited at the bottom of the vessel, where it can be collected; it has great analogy with the colouring matter of the blood. This matter does not appear to be formed in the coloured layer or *gemmules* in which it has its seat; the papillæ are the secretory organs of it, as well as of this layer itself. When we produce by a blister the separation of the epidermis and of the three subjacent layers from the mucous body, the denuded dermis, at first red and deprived of its colouring matter, afterwards takes it again; when the blister is dry this matter is reproduced in the form of little black points which gradually enlarge and are finally confounded together, so that the cicatrix is black though the mucous body may have been removed. M. Gaultier attributes principally to the hairs the function of secreting this matter, because it is more abundant where the hairs exist, and on account of the form it assumes in the case of which we have just spoken; but since it is met with in all parts of the skin, it is not probable that its source is different according to the place it occupies.

Besides, the colouring matter of the skin is by no means stagnant in the mucous body; the modifications, which it experiences under many circumstances, show that it is incessantly brought there and again taken up by vessels, and consequently subjected to a real circulation. Thus various authors cite examples of changes, almost instantaneous, taking place in the colour of the skin, of women becoming black during pregnancy, of men who have experienced the same change from age or extreme grief; thus negroes whiten more or less in diseases, old age, &c. At birth, the negro is not coloured; his skin, similar to that of the white, is red like it, and only

slightly yellowish. It is not till after birth that a brown circle surrounds the nails, eyes, nipples and genital parts; on the third day these parts alone are black; the rest of the body is yet only tawny. On the seventh, the colour is general though pale, and continues so during childhood; its intensity increases gradually in the adult age, without acquiring however the same shade everywhere; the parts that are first coloured remain generally the darkest. These successive changes which are also observed in the other races, are so many evident proofs of the motion of which the colouring matter is the seat.

This matter has the greatest relation with that which colours the hairs, the iris and the choroid coat; thus all these parts undergo the same change as the skin when it is deprived of its colour, as is seen in albinos, from a defect of organization.

The two other parts of the mucous body, viz. the horny layer and the epidermoid membrane of the papillæ, or the two whitish layers are not so well known as the coloured layer. These layers besides being apparent in the negro, are seen under many circumstances. Thus the bulbs of the hairs exhibit on the interior, species of flakes which appear to be formed by the epidermis of the papillæ; when the nail is separated from the papillæ which are below it, as may happen from a blow, these papillæ are covered with a concrete matter which is nothing else than this epidermoid layer. The horny layer, by its extraordinary development, produces all those horny productions which appear on the skin, either in a natural state, as the horns of animals, the scales of fishes and serpents, the nails, &c. or in the state of disease, as the horny substances which sometimes arise on the skin of man; these productions, all situated below the epidermis, evidently belong to the layer of which we are speaking.

The sanguineous bunches, as we have seen, are confounded with the papillæ; these make a part of the dermis or chorion, whose external face they occupy, and ought not to be distinguished from them, as has been done, under the name of *papillary body*. Their arrangement is remarkable; the rugæ which they represent form regular lines separated by very evident furrows, and, in addition, another furrow, not so deep as the first, but having the same direction, divides each of these lines near its summit into two secondary elevations, so that when the skin is cut across perpendicularly to the direction of these lines, the species of curved thread which is seen along the divided edge exhibits undulations alternately large and small; it follows from this arrangement that each prominent line, simple at its base, seems to be composed at its summit of a double row of papillæ.

The structure of these rugæ of the dermis is almost wholly vascular; their analogy with the papillæ of the tongue and the phenomena that are observed in them seem to prove that the nerves are very numerous, and that there is a peculiar venous arrangement, analogous to that of the erectile textures. It is to this very evident arrangement, as well as to the nervous structure, that the papillæ of the tongue owe the kind of erection of which they appear to be susceptible. This erection is evident in the tongue. The papillæ of this organ are soft, flattened and indistinct at the period of digestion, but straighten up and become more apparent during mastication. Something similar is seen on the skin of the fingers; the pulp of this part often acquires in the exercise of touch, a peculiar firmness, tension, and at the same time redness.

It is in the papillæ, that most of the phenomena of vitality, of which the skin is the seat, take place; it is

there that the feeling and touch are exercised; it is there that all the parts which are more superficially situated are secreted, there the colouring matter is formed, there the hairs, nails, feathers, horns, scales, &c. are produced. We cannot be astonished then at the quantity of vessels which terminate there; the whole capillary system of the skin is brought there by the nature of the functions which they perform. This idea however should not be exaggerated, and it must not be thought that there are vessels nowhere else, that the texture of the chorion more deeply situated is destitute of them, and that all go to its surface; the dermis is often injected in its whole thickness, both from inflammation and fine injections; only the surface seems to be more so. By taking from a portion of injected skin, rendered transparent by immersion in the oil of turpentine, a thin strip, cut in the direction of the thickness of the membrane, and by examining it against the light, we do not see in it more vessels on the external than the internal side. Finally, if all the vessels of the dermis were contained in a superficial layer, we might, by scraping the external surface of a portion of injected skin, destroy these vessels, and remove from the dermis almost all its red colour; now, this cannot be done.

Cutaneous Absorption.

Page 298.—" Many modern philosophers have produced numerous negative facts against cutaneous absorption."

This absorption is much less marked than that of the mucous membranes; it is not in fact evident unless there is friction or excitement of the skin, by which the epi-

dermis is opened, raised up, or in part detached, and it does not appear to take place from mere contact; at least there are more facts against than in favour of this last mode of absorption. Bichat explains these facts which are apparently in contradiction to those in which the absorption is evident, by the varieties of sensibility which the skin exhibits; but he has not made the distinction which we have just established, and it is easy to observe that it is when the skin is only in mere contact with the substance subjected to its absorption, that this is the most doubtful. Thus water applied on the surface of the integuments most usually is not absorbed, as Bichat had already remarked, and Symson, who pretends that he has seen a foot-bath sensibly diminished after it had been used by a patient, has been contradicted by all those who have since repeated the experiment. That of Mascagni, in which the inguinal glands are swelled under the same circumstances, is but an insulated fact, and one which besides may not be owing to the absorption of the liquid. It is indeed said, that by holding one hand immersed in a vessel of mercury, and by having in the other a piece of any metal that is susceptible of being attacked by it, as gold or silver, the latter blackens, precisely as if it were in direct contact with the mercury; whence it has been inferred, that the mercury was absorbed on one side and then carried into the blood, which afterwards transmitted it to the opposite side; but is the fact certain, and have all these circumstances of it been observed? Some experiments, made with the greatest accuracy by Dr. Rousseau of Philadelphia, prove on the contrary, that the essential oil of turpentine, the absorption of which is so rapid by the mucous surfaces, as we know, does not produce in the urine that characteristic odour, the unequivocal indication of its absorption, when

it is merely applied upon the skin, taking care not to allow it to be introduced by respiration. Before we admit this absorption, let us wait till new experiments have demonstrated the reality of the absorption by simple contact.

As to the irregularity which Bichat attributes also to the other species of absorption, founded upon this, that the insertion of virus is not always followed with success, it is possible in fact that the virus may not be absorbed in this case; but we should be careful not to confound its passage into the blood with its apparent effect, especially when this effect is purely local, the first might very well take place, and the other not exist.

The same remark is applicable to what most authors say respecting the greater facility of absorption during sleep, hunger, &c. and in general in all the states which dispose to weakness. Contagious and other miasmata are perhaps more active under these circumstances only from the greater susceptibility of the organs.

Some authors have spoken of a gaseous absorption which is constantly taking place upon the integuments, and the result of which they have endeavoured to estimate; according to others, the skin is the seat of an exhalation of the same nature. It is evident that if these two functions exist there, their effect must be confounded, and that it is impossible, by collecting the gases, the atmospheric air, for example, which may have remained on the surface of the skin, to distinguish if the changes of proportion that are observed in them are owing to a diminution of some of their principles or to an increase of the contrary ones, and consequently to determine what belongs to exhalation and what to absorption. It is then incorrect to say, as Fourcroy has done, that the skin gives out azote; the nature of this exhalation, if it

takes place, is very difficult to be determined. Besides, the proof which Fourcroy has given of its existence, drawn from the bubbles that are disengaged from the surface of the body when it is immersed in a bath, does not appear to me to be substantial. These bubbles are nothing but the air which adheres to the integuments and which has become rarefied by the heat of the bath; when all this air has once escaped, the disengagement ceases; these bubbles are not seen to form in the cold bath, the air not having there, from the want of dilatation, the same tendency to quit the surface of the skin.

Sebaceous Glands.

Page 307.—"There is I think as much probability in the supposition of the exhalation, as of that of the secretion of the cutaneous oil."

The existence of the sebaceous glands or follicles of the skin is proved by the following considerations, which have been already in part stated in the article upon the mucous glands.

1st. These glands are apparent in many places, as on the nose, the forehead, the hairy scalp, around the lips, in the hollow of the axilla, in the groin, in the neighbourhood of the nipples and arms, and in general wherever the cutaneous oil is secreted in great quantity. M. Gaultier asserts that the bulbs of the hairs are surrounded, at their orifice, by nine sebaceous follicles destined to furnish the oily matter which lubricates them.

2d. These glands are very variable in their size, and there are subjects in whom they do not seem to exist in certain parts, in which they are found very large in others; so that by thus collecting together all the insulat-

ed observations, there is perhaps no part of the skin in which they may not have been met with.

3d. They often appear suddenly where they were not before distinct, and even acquire so great a size as to constitute a real disease. It is not probable that, in this case, these glands are formed all at once ; their arrangement is too similar to what they exhibit in the places where they are naturally observed.

4th. The same substance everywhere covers the surface of the skin ; the organs which furnish it must then be generally distributed. Now the sebaceous follicles are evidently these organs, in the parts where they distinctly exist.

It may then be accurately deduced from all this, that the sebaceous glands exist everywhere, and that their tenuity alone often prevents them from being perceived ; that consequently the oily fluid of the skin is, as is generally thought, the product of a secretion.

The structure of these glands is analogous to that of the mucous glands, which we have described ; the skin folded upon itself appears in general to constitute them. The membrane which forms them is continued with the dermis ; the epidermis is very apparent in the tumours which result from their dilatation ; these tumours, when cut open and emptied of the matter they contain, are evidently covered on the interior by an epidermis, which is detached from them by maceration with that of the neighbouring skin. The horny layer itself is indicated in these follicles by the productions of that kind which are sometimes developed in them ; in fact, hairs have been seen to derive their origin from them, and horns to arise in them and push out through their orifices ; the coloured layer is also evident in them under some circumstances.

MORBID ANATOMY OF THE DERMOID SYSTEM.

I. *Alterations in the External Forms.*

The skin when distended experiences various changes. (Vide Vol. 3d. *Properties of Texture of the Dermoid System.*) When it is so for a long time, the fibres of the dermis are not only separated, but they are broken in various places; hence the whitish striæ of the skin of the abdomen of women who have been once or many times pregnant; these striæ, often important in legal medicine, because they are constant, are real cicatrices. When the distension has been many times repeated or carried very far, the skin having lost in part its tendency to contract, becomes larger than is necessary to cover the subjacent parts, and remains loose and soft, or forms folds, as is seen on the skin of the abdomen; it is the same phenomenon as that which produces the wrinkles in old people who become emaciated, as has been said elsewhere. Besides, the skin varies in this respect in different individuals; one woman, after the first pregnancy, has the abdominal parietes more loose than those of another, whose abdominal parietes remain smooth and uniform, though she may have had many children. Age has also much influence upon it. The same differences exist in diseases, when a tumour, for example, has violently separated the skin of the neighbouring textures; hence the modifications to be observed with regard to the quantity of the skin to be left, when these tumours are removed, according to the age, sex, idiosyncrasy, size, duration of the tumour, &c.

The surface of the skin is deformed by many productions of a very different nature. Some are the evident product of inflammation ; they will be noticed hereafter. The others constitute peculiar degenerations, and will also be presently examined. But there are some which seem to depend only on a preternatural increase of some one of the layers of which the skin is composed. Thus the horny layer is raised up upon the integuments in the form of hard excrescences, in every respect similar to horns ; the vascular net-work of the papillæ raises the delicate epidermis, and produces exuberances more or less red, such as the growths from syphilis ; the substance of the dermis itself grows and is produced on the surface and forms warts.

The horny productions, respecting which there are many observations in existence, do not depend simply on the cause that we have just pointed out ; they may be divided into three kinds. 1st. In consequence of wounds and ulcers, there is often formed upon the cicatrices productions of this nature. 2d. The sebaceous follicles are also sometimes the origin of these horns, of which Sir Astley Cooper and Sir Everard Home have given examples ; they have then concentric layers such as are seen in trees. 3d. Finally, there are horns which arise irregularly upon all parts of the skin, and which cannot be referred to either of the two preceding species ; these are those especially which seem to have their seat in the horny layer of the skin, and to be nothing else than a more copious secretion of this layer, from the irritation of the subjacent papillæ. Corns on the feet are from a very similar source ; they are formed by a small hard round body, arising from the horny substance of the skin, and covered by the laminæ of the epidermis ; only this species of horny matter is forced by pressure

into the substance of the dermis, and sometimes even below it, instead of growing on its surface.

The enlargement of the sebaceous follicles of the skin produces a peculiar kind of tumours. When this enlargement is inconsiderable, the tumour, hardly perceptible, is discoverable on the surface of the skin only by a black point, from which can be pressed out the sebaceous matter contained in it, and taking the form of the aperture of the follicle, escapes under the form of a small worm, and has even been sometimes taken, on this account, for the larva of an insect; this black point is owing to the particles which float in the air and which soil the entrance of the follicle. When the matter is accumulated in greater quantity, the tumour is more prominent, and constitutes, according as the orifice of the follicle is open or not, those pimples, so common on the face, on the skin of the nose especially, or the sub-cutaneous wens that are seen in the various parts of the body. These never depend on any other cause; all those pretended *meliceris*, *atheromas* and *steatomas*, which are developed on the head, under the hairy scalp, in the sub-cutaneous cellular texture of the extremities, thorax and abdomen, and which differ only in the degree of consistence of the matter which they contain, as their names imply, are at first situated in the substance of the skin, as is easily proved by examining them in their commencement. There may be often observed in the same subject the kind of gradation which these tumours follow in their progress, that is when there are many of them; the smallest then exhibit an opening very apparent on the surface of the skin, whilst the others remove by degrees from the integuments, to which they are still however attached, in the greatest number of cases, by a hollow filament, which is the neck of the follicle elon-

gated by distension. There are no true wens but the fatty tumours. Thus the substance of those called *encysted* perfectly resembles the sebaceous matter of the follicles ; this kind of tumours have, like the latter, an internal epidermis. These last characters would almost alone be sufficient to establish the identity of these tumours with the follicles, if their connexion with the skin in the beginning could not be demonstrated. The opening of the follicles, instead of being obliterated, is sometimes so enlarged, in those small tumours of the skin before noticed, that the bottom of them is almost completely exposed ; their internal surface, in contact with the air, then becomes dry, the tumour ceases to grow, and there remains simply in the place it occupied, a kind of cul-de-sac, continuous with the skin, which appears to be there folded up. This arrangement renders the structure of the follicles very evident.

The whole cutaneous system is the seat of a kind of atrophy, in the marasmus, which succeeds slow diseases; in this case the colouring matter disappears, the dermis dries and is thinner, the papillæ are diminished and the skin becomes rough from the prominence of the bulbs of the hairs which are below it. Opposed to this state is the superabundance of life so common in the integuments of the face, especially in drunkards, and which is shown by the vascular bunches in this part. A long continued irritation may also thicken the dermis, as is often seen around old ulcers.

II. *Alterations in the Organization.*

Cutaneous phlegmasias form a numerous class in pathology ; but their infinite shades are confounded in great measure in the eyes of the anatomist. The alterations

of texture which they produce in the skin are always nearly the same, however numerous may be the eruptions with which they cover it. The common characters of most of the exanthemata, both acute and chronic are an increase of blood in the capillary net-work, and consequently a greater development of this net-work, either generally, or in points more or less precisely insulated; a fluid differing from the blood raising up the epidermis or spread on its surface and forming there various kinds of scabs; the epidermis itself in various ways altered and its regular production often prevented. These affections do not essentially differ except in the degree of excitement which produces them, the different structure of the skin in the parts which they occupy, and the peculiar habit of the persons who are affected with them; all these circumstances produce modifications in their products. Perhaps however this subject deserves new researches; since the seat of these diseases in the cutaneous texture does not appear to be always the same; since tinea, for example, seems to arise more especially from the sebaceous follicles, and some eruptions appear to be confined to the most superficial layers of the skin, whilst in others the whole substance of this membrane is altered. In general, all those who have written upon the diseases of the skin are more engaged in describing minutely the forms they affect upon this membrane, than in investigating the changes they produce in its organization.

Besides, the usual effects of inflammation have been observed in the skin. It suppurates, not only when its epidermis is removed, as from a blister, but even when its texture is sound, in the same way as the cellular texture; the pus is usually in small cavities which raise up the epidermis, as is seen in the pustules of the small pox. Ulceration is frequent in this membrane, less so however

than in the mucous system ; it is sometimes connected with suppuration, as is commonly observed in the small pox; at other times it is the effect of a peculiar cause, such as syphilis. It is necessary, moreover, to distinguish those cases in which ulceration proceeds from without inwards, from those in which the skin is distended, at first only becomes thinner and is finally inflamed and destroyed, from within outwards, as takes place in abscesses, aneurisms, &c.

Simple wounds of the skin heal quickly, and without the formation of fleshy granulations. A plastic layer, analogous to that which is formed between the other divided textures, and which M. Brachet has found to be composed of gelatine and albumen, reunites at first weakly the edges of the wound, which can in the beginning be separated afresh, without giving hardly any pain, or occasioning the flow of blood, with which this layer is not yet penetrated. Vessels are afterwards produced in this substance, which at the same time acquires more consistence, and the cicatrix is complete. This cicatrix is soon confounded with the texture of the skin, from which it finally cannot be distinguished.

The phenomena are also very simple when the skin is destroyed only in its superficial layers, and the dermis is merely denuded; the epidermis is then reproduced with great rapidity over the whole extent of the wound ; this is what is seen in blisters, burns of the second degree, slight excoriations, &c. If however the irritation is great, as in a burn, suppuration comes on, and the cure is not so speedy ; but fleshy granulations are not formed unless the suppuration is long continued, as in blisters.

On the contrary, these granulations exist necessarily when there is a complete loss of substance of the skin, and the lips of the wound remain separate ; they always

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precede in this case the formation of the cicatrix, which then arises from the various textures laid bare, particularly from the cellular.

The skin is but little subject to organic transformations. It acquires under some circumstances all the characters of the mucous membranes; this takes place, when it is long in contact with itself and deprived for a length of time of the air on its exterior; a less thickness of the dermis, a greater redness of its surface, which continually pours out a copious mucous fluid, and an extreme delicacy of the epidermis, covered with very distinct villi, are observed in this case, an example of which is cited by Hébréard in which this alteration was produced in the hollow of the ham, in a paralytic patient, by the constant flexion of the leg upon the thigh. We have seen, in the Cartilaginous System, that the skin sometimes experiences the cartilaginous transformation.

The cancer of the skin assumes a peculiar form which is only observed in this membrane and in the mucous system; it constitutes most often ulcerations around which the neighbouring texture is little altered, so that in an anatomical view, there is no resemblance between these ulcers called *carcinomatous* and the other cancerous affections. There arises also upon the integuments, in some cases, excrescences analogous to the cancerous polypi of the mucous membranes. In the sub-cutaneous cancerous tumours, the skin is subsequently affected in two different ways; sometimes it contracts a very great consistence, a remarkable kind of hardness at the same time that it adheres intimately to the parts which it covers; sometimes it ulcerates from within outwards, as takes place in the ordinary termination of cancer.

III. *Alterations in the Development.*

The defects of conformation of the Dermoid System, are, 1st, absence of the skin to a certain extent, where it usually is found, which is scarcely ever seen unless there is at the same time a want of the subjacent parts, as when the cavities of the mucous membranes exhibit preternatural openings; 2d, various elongations which the texture of the skin forms, and with which the surface of this membrane is covered; 3d, the spots from birth or *nævi materni*; these are sometimes merely an alteration of the colouring matter, sometimes an affection of the vascular net-work, and most often become in the latter case after birth, tumours that are called *varicose*, and which have much analogy with the erectile textures. The spots are often covered with hairs.

New integuments are preternaturally produced whenever the parts naturally covered by the skin are deprived of this common covering, as after wounds, ulcers, abscesses, gangrene, &c.; the new texture which is formed under these circumstances constitutes the *cicatrix.* I would observe, upon this subject, that this word serves to designate all the modes of union which take place between divided parts; now there is a number of these modes, and consequently several species of cicatrices. 1st. There are those which succeed the internal ruptures which various organs experience, the skin which covers them remaining sound; those of the different systems have been examined under each one of them in particular; we have seen that they partake in general more or less of the textures in which they are situated, though an analogous cause, an exudation of a substance capable of

concretion, most often presides over their formation in the beginning. There are no fleshy granulations when these cicatrices are completed. 2d. The union of wounds by the first intention furnishes a second kind of cicatrices, which has great resemblance to the preceding, and which only differ from them in this, that the divided textures communicate at first on the exterior, a circumstance which their mutual contact soon renders nothing, so that this case is then the same as the first. The skin and the cellular texture perform the greatest part in this union, which is effected, like the preceding, without the production of fleshy granulations. 3d. Finally, cicatrization properly so called is the mode of cure of wounds, and, in general, of all solutions of continuity that are apparent on the exterior, whose neighbouring edges remain separate, whether because they have suffered too great a loss of substance, or because the effects of contractility of texture have not been prevented, or because the structure of these edges renders their approximation impossible, as in wounds of the bones. There is in this case, the only one which we should notice here, suppuration, formation of fleshy granulations, and consequently of a membrane analogous to the skin. This membrane is everywhere the same, whatever may be the denuded texture, as is proved by the homogeneous cicatrices which succeed amputations, wounds of the cranium and the thorax, in which parts of a very different nature are concerned; the cartilages are the only organs which do not contribute to its formation.

Two periods may be distinguished in the cicatrization of a wound; 1st, the wound is covered with fleshy granulations; 2d, an epidermis is formed upon these granulations, to give origin to the cicatrix. It would be easy to show that there is a greater number of these; but these

are sufficient to give an idea of the mechanism of the production of the cicatrices. These periods are described in Bichat, Vol. 1st. We shall now pass them rapidly in review.

First Period. The small bodies so improperly called *fleshy bunches*, and which have also been known by the name of *caruncles*, *granulations* and *cellular* and *vascular bunches*, arise in proportion as suppuration is established, but with a different rapidity in the different textures; in an amputation, for example, they are developed in the first place upon the cellular texture which occupies the interstices of the other parts, in the second place on the surface of the divided muscles, soon after on the fibrous organs, and still later in the bones, most often in these last not until a delicate lamina is detached from them; in general they are produced so much the quicker as the textures are more cellular and vascular. The size of these bunches varies; their arrangement is so much the more regular in proportion as they are smaller, and the cicatrization of them is also quicker. The membrane which they form by their union has below it a compact cellular texture, appearing as if penetrated with concrete albuminous fluids. This membrane contains blood vessels, for the bunches bleed from the least touch, and redden or become pale from various causes. The absorbents are not demonstrated in it, except by the absorption which these bunches perform, and by the ulceration to which these are so disposed, that often by a deviation in regimen, they totally disappear in less than two hours from the surface of a wound; their extreme sensibility leads to the belief that there are nerves in it, though they have never been seen. The membrane of the fleshy bunches is endowed with a very evident contractility, which explains the real contraction and diminution of

wounds, which is so much the more evident as the skin is at the same time more moveable and extensible. The cellular nature of this membrane has been demonstrated elsewhere ; many authors consider it, with Fabrus, as a mere extension of the cellular texture; but the opinion of Hunter, which has been more fully explained by Home, is more probable. This opinion, which I have given in the Additions to the Cellular and Capillary Systems, consists in considering it, not as a preexisting cellular texture, but as a new production, not being able to be formed except where there are cellular texture and blood vessels, and exhibiting in its development phenomena analogous to those of the natural development of the organs.

Second Period. When the fleshy bunches have retracted as much as the resistance of the integuments in the neighbourhood of the wound will allow, they are covered with epidermis, which constitutes the second period of cicatrization, the formation of the cicatrix. The new epidermis begins to be formed at the circumference of the wound, where it is evidently continued with the neighbouring epidermis, and afterwards advances by degrees towards its centre ; sometimes, as in large ulcers of long standing, it is produced at the same time in small particles in the middle, and the various points afterwards unite together ; the pus ceases to be secreted in proportion as the epidermis is formed. The cicatrix is complete when the whole extent of the wound is covered with epidermis. This cicatrix, delicate at first, soft, reddish on account of the want of thickness of the epidermis which covers it, more adherent and less solid than the skin, finally becomes completely analogous to this membrane. The cellular texture which is below it regains by degrees all its extensibility, unless the cicatrix rest upon a bone ; in this case it remains adherent.

The new cutaneous texture when perfectly developed, exhibits the following characters. 1st. This texture is more dense than that of the skin and has a greater resemblance to the fibrous textures; fewer blood vessels enter it, hence the white colour of the cicatrices and the rareness of their preternatural redness. 2d. The dermis, which is met with in it, has less evident areolæ, and less distinct fibres and laminæ than that of the skin; this dermis is in general destitute of papillæ, as the smooth and shining appearance of its surface indicates. 3d. The epidermis is very apparent in cicatrices, and is confounded with that of the surrounding skin. 4th. Camper has denied the existence of the mucous body in it; but this body is demonstrated there, in negroes, by the colour of which their cicatrices are the seat. This colour exists in almost all cases; only a sufficient length of time is required for it to be developed, and the tint it assumes is almost always paler than that of the integuments; however in some rare cases, this tint has been seen of a deeper colour. The horns which arise upon the cicatrices indicate in them the presence of the horny layer. 5th. The texture of the cicatrix is more disposed to ulcerate than the skin properly so called; ulcers which affect at the same time these two membranes make much more rapid progress in the first than in the second.

ADDITIONS

TO THE

EPIDERMOID SYSTEM.

Means of union of the Epidermis with the Dermis.—
Exhalant and Absorbent Pores.

Page 351.—" By separating the epidermis by maceration, which is the most proper means, we see on its internal surface many small elongations of greater or less length, and which, when examined attentively, appear to be nothing but the broken extremities of exhalants and absorbents. In fact these little elongations . . . have all of them an oblique course, and terminate in the pores which, we have said, pass through the epidermis to go to its surface."

The nature of the elongations which are intermediate between the dermis and the epidermis, and which can only be seen by separating these two parts from each

other, is not easily ascertained. Kaaw Boerhaave and W. Hunter maintained, which is nearly the opinion of Bichat, that they were the vessels of the sweat or the cutaneous transpiration. But injections do not reach these elongations ; inflammation, which renders the whole skin vascular, does not colour them sensibly. Cruikshank considers these filaments as epidermoid substance which has dipped down into the areolæ of the dermis. But do these elongations really exist when the epidermis is adherent to the dermis ? Nothing proves it. They should rather be considered as species of mucous tracts which are formed by the separation of the substance intermediate to the dermis and the epidermis, rendered fluid and viscid by putrefaction or stewing to which the skin is subjected for the purpose of separating the epidermis.

The existence of the pores themselves, such at least as are usually represented is far from being accurately demonstrated. Physiological considerations, and even the injections of Haase would lead to the belief that the openings of the vessels go to the last layers of the skin, that is to say, to the epidermis ; but microscopical examination, which is more worthy of confidence than physiological conjectures, does not detect pores in the epidermis. By examining against the light the epidermis of a portion of skin from which the greater part of the hairs has been removed, there is seen very distinctly transparent places which have been regarded as openings. Leuwenhoeck thought even that he discovered pores in the epidermis, and he has given a drawing of them in his *Arcana Naturæ.* But as this great observer used only simple lenses, which magnify but about a hundred and sixty times, he has perhaps mistaken for pores the foramina of the hairs. Fontana, in his work upon the venom of the

viper, speaks of a texture composed of serpentine vessels which he has seen by the aid of the microscope; but M. de Humboldt, who has examined the human epidermis with a microscope that magnifies 35,200 times, asserts that the serpentine cylinders are folds and not vessels; in some observations made upon the epidermis magnified 312,400 times, he was unable to discover pores in it. I have closed the extremity of a tube with a piece of epidermis, the tube containing a column of mercury of more than two feet, and not a particle of the metal passed through the epidermis.

It must be concluded from these different observations that there is on the surface of the skin a non-vascular barrier between organization and the atmosphere, and that whether for entrance or for exit, substances must penetrate this barrier by a sort of imbibition, which would approximate this extreme part of the organization, to the most simple bodies of either organic kingdom, which are destitute of vessels. In fact, as we have just said, there are neither vessels, pores nor any opening discoverable by the microscope, whether the oblique insertion of the hairs conceals those which give passage to them, or whether the epidermis furnishes a sheath for them which exists after their removal and fills the foramina with which it is pierced. We cannot however deny absolutely, the existence of the pores from microscopical examination alone; for if we make a puncture in the epidermis with a very fine needle, we cannot discover this opening by the microscope, as Cruikshank has proved by experiment; the same thing takes place in a very delicate lamina of gum elastic or caoutchouc, in which a very narrow opening is made; on the contrary, the opening continues when perfectly dry epidermis is employed; paper that is used for filtrating presents the same difference accord-

ing as it is dry or moist. This point, which has been much discussed by authors, does not appear to me to be yet sufficiently clear.

Epidermis of the Mucous Membranes.

Page 369.—"What is the place in which the epidermis terminates that lines the origin of the mucous surfaces, or if it exists everywhere, where does it begin to become no longer apparent from the action of our different reagents? We cannot, I think, determine with precision; it diminishes in an insensible manner, and is lost as it were by degrees."

Bichat leaves here two questions unsettled; the first is to know if the deep-seated mucous surfaces have an epidermis; and the second is, at what place this epidermis ceases or changes its nature. The soft and pulpy state of the deep-seated mucous membranes, the very great resemblance which exists between the composition of the mucus and that of the epidermis, and the presence of villi where this is but little apparent, lead to the belief that it is in fact wanting in deep-seated parts. On the other hand, those who admit its existence there cite the cases of inversion of the rectum, of the small intestines in preternatural ani, of the uterus, &c.; in which a distinct epidermis covers the whole of these parts; they rely also upon the membranous excretions, which, according to them, have no other source. These reasons are by no means decisive; there is no proof that the epidermis of the preternatural ani, for example, exists originally, and that it is not formed afterwards entirely by the contact of the air. As to the membranes voided in phlegmasias of the intestines, the bladder, &c. analogy should teach us

to regard them as false membranes of the same kind as those which cover under the same circumstances the eye, the mouth, the pharynx, &c. However it may be possible that a very delicate epidermis, the fineness of which would render it still more difficult to be perceived, may be found upon the deep-seated mucous surfaces; this first question can hardly be resolved otherwise than it has been done by Bichat, who is much inclined to the negative.

The second leads to something more positive. In many parts of the mucous system, there exists a very evident line of demarcation between the portion of this system placed near the exterior and that which is more deeply situated. This line is owing to the epidermis of the first, which ceases where the second begins. Boil the mucous coat of the stomach and that of the oesophagus, the epidermis, raised up upon the latter, will soon form a bunch corresponding exactly with the cardiac orifice, and beyond which this epidermis will cease to be apparent. This is what has even led to the assertion that there was at this place an interruption in the mucous system, and that the mucous membrane of the stomach was not a continuation of that of the oesophagus. But the epidermis alone forms this limit; the rest of the membrane is continued perfectly. This is so true, that in animals, the line of demarcation does not always correspond with the cardiac orifice, and often this line encroaches more or less upon the stomach, as is shown in the plates of Home, in which it is seen to approach nearer and nearer the pyloric orifice, according to the species of animal. It is the same case with the mucous membrane of the vagina in relation to that of the uterus; its epidermis terminates at the neck of this viscus, the interior of which is not the less lined by a peculiar mu-

cous membrane, differing from the first only in having a less degree of thickness and fewer villi. The same arrangement exists at the neck of the bladder, as is proved by the experiment noticed above, made upon this viscus, and the urethra which is inserted into it. This remark applies in general to all the mucous ducts which open on the exterior, and terminate in a membranous reservoir.

Nature of the Nails.

Page 375.—"We cannot consider these" (the nails,) "as mere layers of epidermis applied to each other."

Malpighi regarded the nails as the consequence of the drying of the papillæ of the dermis. Ludwig said that they arose from the dried nervous substance. The examination of the horny parts of animals shows that they are formed by a horny substance, of the same nature as that which constitutes the hoofs, horns, scales, &c. of various animals. The epidermis only covers these parts, which all belong to the horny layer which is subjacent to it; when it is wanting on their surface, it is because friction has destroyed it, or that it is confounded with their superficial laminæ, as is seen particularly with regard to the nails.

Considered in animals, these are of two species. 1st. They are such as resemble those of man, these are the small nails (*onguicules.*) 2d. Others differ from them in their arrangement have received the name of nails (*ongules*); they include the hoofs of various quadrupeds. We might add to them the horns, the origin of which is precisely similar to that of the nails and the hoofs. It is necessary however to distinguish among these the horns

of deer, and the horns properly so called, or those of ruminating animals. The first are entirely osseous, and raise up the skin, instead of being seated on the surface of this membrane; the second alone belong to this surface; only they usually surmount osseous elongations, to which they serve, as it were, for sheaths. The nails of man are not coloured; those of animals and their horns are so on the contrary quite often; their colouring matter appears to reside in general, in the horny substance itself.

The nails and the horns are formed by the same mechanism. When a horn is torn out of an animal, the papillæ in a high degree vascular, which have been laid bare, pour out a fluid matter which can be seen at first to rope between the fingers, if we may be allowed the expression, and which afterwards thickens and hardens by degrees; below this first layer, there is formed a second which raises it, and then a third, and thus in succession, so that a new horn results from this successive union of layers; this horn continues to grow from its base in the same manner, the new layers constantly raising the old ones. Now the same thing is observed in the hoofs, as also in the reproduction of the nails of man. The form alone differs, because the parts secreting the fluid are variously formed. When the nail is torn out, the papillæ, after having bled copiously, and appearing bare though having still above them the deep-seated whitish layer, are covered with a soft, white lamina, the consistence of which gradually increases; then new laminæ are produced below, so much shorter as they are more distant from the root, and give to the new nail the thickness which it is to have; the ulterior growth depends on this, that the horny substance is continually poured out at the extremity of each of the laminæ, which

occasions the whole of the nail to be pushed forward. This mode of development may be compared to that which takes place in the silk worm, the fluid of which is constantly reproduced in proportion as it acquires consistence, and constantly pushes before it the fluid which has preceded it. Thus the nail would grow indefinitely if it were not habitually cut, or worn off by friction.

The longitudinal striæ which the nails exhibit on their surface are no indication of a fibrous structure; these striæ appear to depend on the arrangement of the subjacent papillæ.

MORBID ANATOMY OF THE EPIDERMOID SYSTEM.

The parts comprised under this system having no organization, properly speaking, are subject to but a small number of alterations, which even are not inherent in them, and depend only on the changes that are experienced by the vitality of the skin, their common support. It is with these parts as with the different fluids that are poured out upon the mucous, serous, synovial surfaces, &c. and the alterations of which depend entirely on those of the organs which furnish them.

The epidermis thickens, becomes thin, is raised up on the surface of the dermis and destroyed by various causes, the most of which have been already examined. It assumes the form of vesicles, blisters, furfuraceous scales and large plates, when it is raised up or almost entirely detached. Its reproduction, usually easy, sometimes becomes impossible from the great irritation of which the

skin is the seat, as in a burn or chronic pemphigus, and then the patients suffer much, the mucous body being bare. At other times, the skin, red and swelled, furnishes, instead of the fluid which produces it, a scabby, crusty matter, joined to a serous fluid which oozes out copiously, as is seen in some species of herpes.

The excrescences of the nails are especially frequent in the dry herpes, in which the skin assumes the appearance that has been compared to the lichens of trees, in which the epidermis is thickened and cracked in various directions. They come upon the toes, from a cause analogous to that which produces corns upon them. In some cases, they appear to be owing to the progress of age.

The nails become soft and brittle in individuals affected with scrophula and herpes. They exhibit also besides, in some cases, a peculiar alteration which authors do not appear to me to have described. It consists in a sort of chronic inflammation of the skin which surrounds the root of the nail; a brown circle, painful when pressed, is formed at this place; the nail becomes at the same time thin and like a membrane. Buzzi has given some examples of this affection, which I have many times observed in children, and sometimes in adults.

The very improper expression of *the nail growing into the flesh* serves to designate a state in which the skin surrounding the nail upon the edges or near its extremity goes beyond it and advances more or less upon the free face. There results from it pains more or less acute by the pressure which the cutting edge of the nail makes upon it. This inconvenience hardly ever happens except to the great toe, in which the tightness of the shoes often produces it. The extraction of the nail is the most efficacious remedy for it.

ADDITIONS

TO THE

PILOUS SYSTEM.

Structure of the Hairs.

Page 401.—“ White hairs may experience vital phenomena, of which, I believe, there are a few examples. But all this is subordinate to the future experiments which will elucidate the pilous structure more than it now is.”

This structure exhibits some new peculiarities which we shall state.

The bulb of the hairs, or the kind of canal from which they derive their origin, is in fact a small sac lodged in the substance of the skin or in the sub-cutaneous cellular texture, and receiving the extremity of the hair which is implanted in it. This bulb is not very evident in man,

but has been described by Chirac and Gaultier, from its arrangement in the hairs of the whiskers of some animals, its size in them rendering its structure more evident. It appears to contain like the sebaceous follicles, the same parts as the skin, and to be continued in the same way with this membrane. A layer analogous to the dermis is the base of it, and is evidently continued with the dermis of the skin. Within this layer there is an elongation of the mucous body, the continuity of which with this body is seen very well in animals whose skin is coloured ; this part is soft and more easily perceived than the skin ; it is composed, as in the skin, of many layers. The epidermoid layer is the inner one ; it is less distinct than the others, but it is found in feathers, which have a great analogy with the hairs, and in the quills of quadrupeds, which are only hairs made very strong. A conical papilla, similar to the asperities of the dermis which surmount the palm of the hands, the sole of the feet, &c. fills the bottom of this kind of follicle.

The bulbs of the hairs receive vessels and nerves. The nerves constitute in great part the elongations which go to their external face, and which occupy particularly their extremity opposite to the skin, they form for them a sort of pedicle. Many anatomists have traced these nerves in animals ; in man even nervous filaments are seen to penetrate the bulbs of the eyelashes and those of the hairs situated at the opening of the nostrils. The vessels are also situated, according to some, in the substance of the elongations attached to the bottom of the bulbs; but M. Gaultier has seen them entering at the other extremity, coming from the dermis of the skin, and enclosed between the dermoid layer of the bulb and the mucous layer.

The neck of these small sacs is surrounded with sebaceous follicles, pouring out an oily matter, which covers

the surface of the hairs, and the use of which is to render them less brittle. M. Gaultier thinks that there are nine of these follicles, which are very small.

The body of the hair embraces by its root the papilla of the bulb from which it arises ; it is joined to the papilla in this place, nearly in the same way as horns and feathers are united to the elongations which serve for their support. In the interior of the bulb, the hair is covered by a sheath which is furnished by the epidermis, and which is evident in the quills of quadrupeds, and especially in feathers; this sheath is discontinued at the place where the hair traverses the skin to go out, or at least it cannot be traced beyond there, perhaps because it is broken off even with the integuments.

The structure of the hair itself is a point that is not yet well understood. This part seems to be, like the feathers, horns, scales, &c. a production of the horny layer of the skin; but it is difficult to ascertain the internal arrangement of the substance which composes it. The bristles of the wild boar are formed by twenty filaments leaving in their interstices one or two canals which contain a peculiar marrow. On the contrary the hairs of the elk, hedge hog, &c. have no filaments; they are constituted by a horny tube, filled with a spongy and coloured substance. Hence there are two different opinions in relation to the structure of the hairs in man. Some pretend that they are filaments in juxta-position ; according to others, their arrangement is that of a tube. Both of these opinions seem to be equally well founded ; 1st, on the one hand, by examining against the light a black hair, the edges of it are whitish and transparent, which seems to show that the exterior of the hair is of a different nature from that of the interior, but which may be also owing to this, that the edge being thinner, the colour

must be less evident in it; 2d, on the other hand, the hairs in man can be divided into many filaments, which either depends upon their structure, or the division is purely mechanical. On the whole, the minuteness of the objects prevents us from deciding on this subject. Only it is certain that there is a colouring matter in the hair, and that this matter occupies the interior of it. The hair is dyed with such substances as the preparations of lead which only colour it by the chemical action they exert upon this matter. But it is not known whether it undergoes a sort of circulation in the hairs, or if when once deposited, it is wholly beyond every motion of the fluids. This matter is secreted with the hair itself within its horny substance.

From all that precedes, it is evident that the two elements of the hair, the bulb and the body or the hair properly so called, have nothing in common in their structure, and consequently in their properties; that the hair, properly so called, is almost inorganic, like the epidermis and the nails, whilst its bulb on the contrary enjoys a very considerable degree of vitality. Hence why the hairs, though insensible themselves, transmit such painful impressions when they are pulled; why they are so useful in animals with whiskers, as organs of feeling, the least jar which agitates their extremity being felt in an instant; why, in diseases, the hairs are influenced by various organs, the functions of their bulbs being deranged by their connexion with the other functions; and why nevertheless they remain most often foreign to all the disorders which take place in the economy, and do not feel them for a length of time, &c. This sort of productions should be considered as the result of a real excretion of which the bulbs are the seat. Thus the hairs grow only at their base, like the nails, of which it

is easy to be convinced by observing this growth upon hairs artificially dyed, or upon which an indelible mark has been made ; the distance of this mark from the surface of the skin increases only as the hairs lengthen ; and it is only near this surface that the colour of the hairs which have been dyed seems to disappear, in proportion as their substance is developed anew there. The celebrated Mascagni has again brought forward, in a posthumous work, an opinion which has been many times before thrown out upon the structure of the epidermoid, horny and pilous parts ; he regards them as a texture of lymphatic vessels, and he attributes the same texture to the enamel of the teeth and to most of the organic textures. But this vascular structure, which Hedwig has represented with so much truth in the epidermis of plants, does not appear to exist in the epidermis, hairs and nails of man and animals.

MORBID ANATOMY OF THE PILOUS SYSTEM.

Preternatural whiteness is the most common alteration of the hairs. Much has been said of the hairs having become suddenly white, and over the whole extent of the cranium at the same time ; Bichat has even cited examples of this fact. But have these cases been sufficiently observed ? They should be doubted, I think, especially as no one of them has been related with the necessary details, until new observations confirm or destroy them. If the facts are correct, they would tend to prove that there is circulation in the hair. Those that are well

known only prove that an appearance of sudden discolouration may take place, when the hairs fall out and are replaced by others of a different colour. This is what is often seen in phthisical subjects who have intervals of almost perfect health ; it then happens that their hair, which had become white during the paroxysm, falls out and is replaced by black, which it was before ; Dr. Chaumeton exhibited this phenomenon a short time before his death. This may be repeated many times successively, and the hairs may be thus alternately coloured and colourless according to the general state of the individual. In ordinary cases, the change of colour does not take place in all the hairs at once, but successively in each of them ; it begins at the root and gains little by little, in proportion as this is extended and the end worn by the action of foreign bodies ; this is easily explained by the change that comes on in the secretion that is made in the bulbs.

Alopecia (or the falling out of the hairs) is accompanied, under some circumstances and not under others, by a sort of atrophy of their bulbs. This lesion is sometimes the consequence of a long-continued irritation, as in tinea ; at other times, though rarely at the present day, it is owing to syphilis ; but an infinity of other causes may also produce it. The state of the bulbs in these different cases has not been examined.

The *plica* is an affection also, the nature of which is but little known. The best observers are not agreed as to what takes place in this disease ; according to some, the hairs acquire sensibility, and are penetrated with vessels ; others assert that they are only matted together. It would be possible to reconcile these two opinions by admitting that the hairs become merely vascular at their base, by an extraordinary growth of the papilla contained

in their bulbs, a growth which would raise this papilla above the level of the external face of the skin, and whose primitive irritation having caused the disease, or that secondary one resulting from want of cleanliness, pulling the roots of the hairs, &c. would easily explain it. The plica would then produce a phenomenon analogous to what is observed in feathers, in young birds; if the papillæ of their feathers exceed the level of the teguments, they bleed when they are cut.

Preternatural hairs are met with, besides under the circumstances noticed (Vol. 3d,) on the surface of the skin, and in consequence of the inflammation of this membrane; M. Boyer mentioned in his lectures the case of a woman whose thigh was covered with long, rough hairs, after erysipelas. Among the cysts which contain hair, should be noted those situated in the superior eyelid, near the eyebrow; their hairs resemble completely those of the eyebrow, and appear to be only some of them which have deviated from their usual direction. The hairs contained in the cysts of the ovarium are delicate, silky, light coloured, usually free from all adhesion and sometimes swelled at one of their extremities. It is extremely rare that hairs arise in cysts formed in other parts. Hairs are sometimes found in the meconium of new born infants; their origin is but little known; it is supposed that they existed originally on the skin of the fœtus.

PRETERNATURAL TEXTURES.

IT remains for us, in order to complete the summary notice of the principal changes which the organic texture undergoes in diseases, to speak of the degenerations common to all the systems previously studied, and which, not belonging in their nature to any single one of them, could not be examined in their particular history. The description of these degenerations will be at the same time a sort of completion of the General Anatomy, the different simple textures of which have embraced, in addition to the natural organs of the economy, only the preternatural productions which are analogous to these organs. In fact, the degenerations, though always resulting from a species of transformation or degeneration which affects the natural textures in consequence of the morbid phenomena of which these textures are the seat, are really, when once formed, independent to a certain extent, of these textures, have in the midst of them their peculiar life, seem as it were to be new organs superadded to all the others, so unlike are they to those which have given them birth, and are entitled from their structure and peculiar properties to form a distinct class, or if it be preferred, a system, under the name of *morbid or preternatural textures.*

These textures, considered in this point of view, present a certain number of common characters, which at the same time mark the difference between them and the natural textures of the economy. 1st. Their structure is in general homogeneous, and though they seem to contain various organized elements, as vessels and cellular texture, those fibres and laminæ which characterize most of the organic textures are not seen in them. 2d. They have not, like them, a uniform organization; their most important properties, such as colour and consistence, change in their different periods; in general hard and firm in the beginning, they soften and become fluid even in part, at a more advanced period, which is precisely the reverse of the other textures. 3d. Far from being able to perform uses in harmony with the other functions, as is sometimes done by the natural textures when preternaturally developed where they ought not to exist, their presence always produces more or less remarkable derangements in the action of the organs; emaciation, slow fever and death are often the consequences of them. 4th. They have not a permanent existence in the economy, but have uniformly a tendency to be destroyed at a certain period; sometimes, it is true, this period is late, and they remain for a long time in the same state, making a part of the organization, like the natural textures, it is especially at the period of their destruction that they affect the health. 5th. The diseases which affect them have a peculiar progress and effect; thus inflammation uniformly produces in them the greatest derangements and a rapid destruction, which are propagated to the surrounding parts.

The different preternatural textures may be met with in almost all the organs; but there are some which they more particularly affect; often in the same subject, they

are found distributed at the same time upon a great number of points. These textures frequently increase the size of the parts which they occupy, and form tumours prominent on the exterior. Their apparent situation, in relation to the organs, presents in general, two varieties; in one, they seem to be interposed between the textures which compose these organs; in the other, these textures disappear, and are replaced by the preternatural production.

How are these textures produced in the animal economy? Bayle and Laennec attribute their development to a particular disposition of an unknown nature, which exists in certain individuals, and regard the external causes which are commonly assigned, at most as only occasional circumstances, which favour the action of this occult cause. Broussais, on the contrary, assigns to these causes the principle part; according to him, these productions are uniformly a result of inflammation, and take place when, in this, the white vessels and the lymph which they contain are especially affected, the irritation not being sufficient to bring the red part of the blood; the albumen variously combined with the textures, is the basis of these productions. J. F. Meckel calls the proximate cause of this kind of alterations, and generally all the alterations of texture, an *abberration of the process of growth;* he explains all these lesions in the same way, as J. Hunter and Abernethy do, by the effusion of a fluid albuminous matter, taking various forms and requiring a peculiar and imperfect mode of organization. Others consider them as productions analogous to the cryptogamous vegetables, and which are nourished and grow either by imbibition, or by a real vascular circulation. Disregarding these theories, which are more or less well founded, we shall treat only of the anatomical characters

of the preternatural textures; whatever may be the origin of these textures, it is important to know them.

But they exhibit in this respect many differences, which are not however striking, but are confounded with each other by insensible shades; besides, the parts in which they are situated, though not absolutely having an influence upon their nature, make them however vary a little, so that the study of them becomes very difficult; thus authors are not agreed in the classifications which have been given of them. Some have made many textures of the same production examined at different periods of its development; we have already noticed this source of error. Another, not less real, is that oftentimes many of these alterations are united together, whether they form different distinct parts of one texture, or whether they are intimately intermixed in this texture. This union may take place not only between morbid textures properly so called, but also between these and the preternatural textures to which there are analogous ones in the economy; the osseous and fibrous productions, for example, are often joined to the first, as is seen especially in the ovarium, the thyroid gland, &c. Hence it follows that all these textures are far from being equally well known; that daily observation shows productions which do not resemble any of those hitherto described; and finally that there are very common alterations, as the polypi of the mucous membranes, fungi of the dura-mater, &c. that we know not where to class, and which appear to consist sometimes in a simple hypertrophy, and sometimes in a real degeneration. The only preternatural textures which have characters at all striking are, 1st, Tubercles; 2d, Scirrhus; 3d, Cancer; 4th, Melanosis. We shall now examine them in succession.

I. *Of Tubercles.*

Tubercles, or scrophulous tubercles, so called from their form which is commonly round and from their most frequent cause, exist under many forms, which are so many degrees of this degeneration, and which may be all included in two periods, the one of crudity in which they are in a solid state and the other of softening. M. Broussais considers this last as a true mode of suppuration peculiar to this texture, and resulting, like ordinary suppuration, from the inflammation which is developed there.

First Period. Greyish granulations, semi-transparent, quite firm, from the size of a grain of millet to a grain of hemp and irregularly distributed, usually constitute tubercles in the beginning. Bayle, who observed them in the lungs in this state, thought that it was an alteration different from tubercles; M. Laennec has proved that it is not so. These grains, as they become larger, assume another aspect; they often unite together, and form more or less considerable masses; they always become opake and yellowish, at first in their centre, and then on the circumference, nearly in the same way as cartilages which are ossified, and acquire at the same time the consistence of hard cheese. This state, which is properly that of the *crude* tubercle, is not always distinctly preceded by the first, in which the tubercle is called *miliary*; there sometimes takes place in the beginning a sort of infiltration or impregnation of tubercular matter, which suddenly invades a certain extent of the affected organ which becomes greyish, more dense and semi-transparent; yellow and opake spots afterwards appear in this place, and the second state comes on.

The tubercular texture adheres most often to the sound texture which surrounds it, it sometimes even seems to be continued with this texture, and at others, on the contrary, it is separated from it with the greatest ease. In some cases, a membrane in the form of a cyst surrounds the tubercle; this is especially when the tubercle is developed slowly. This membrane is not always of the same nature; sometimes soft, and as it were, like the integuments of pork, sometimes more consistent, it sometimes becomes cartilaginous and even osseous; it appears to be the result of an exudation.

The vessels are separated or obliterated by the tubercular substance; they are not visible in the masses which it forms.

Second Period. The tubercles soften and melt as it were from the centre to the circumference; they are converted sometimes into an opake, thick, yellowish matter, which very much resembles cream, sometimes into a clear and transparent fluid, in which flakes similar to cheesy matter are seen to swim. The evacuation of these products has taken place, as in abscesses, sometimes externally and sometimes internally; the centre of the disease, which is usually lined by a membrane of new formation, analogous to the cyst of which we have spoken above, cicatrizes, or continues open, and brings on suppuration and ulceration of the texture, which forms the parietes of it, or finally remains always, but is clothed with a dry, semi-cartilaginous membrane, as was first observed by M. Laennec.

II. *Of Scirrhus.*

The scirrhus texture is firmer than the preceding; its consistence varies from that of the cartilages to the softness of the inter-vertebral fibro-cartilages; it makes a

noise under the scalpel. Its colour is white, slightly blueish; cut in thin slices, it appears semi-transparent. It forms more irregular masses than the tubercular texture; it softens in the same way, and is then changed to a transparent, greyish or reddish matter when a little blood colours it, exhibiting the appearance of a jelly or syrup.

The pancreatoid, mammary, (analogous to the texture of the mamma,) and tubercular sarcomas of Abernethy should be considered as varieties of scirrhous. In the last of these three, the name of which is improper, since it is agreed to give the name of *tubercles* a particular kind of texture, and not a variety of form, the scirrhous mass is divided into distinct lobes.

III. *Of Cancer.*

In pathology, various alterations have been designated under this name, among which scirrhous, which we have just examined, has often been comprehended. We shall understand only by *cancerous texture* what some have called *soft cancer;* it is the *cerebriform or encephaloid matter* of M. Laennec, the *fungous inflammation* of Burns, the *fungous hematodes* of Hey and Wardrop, the *medullary sarcoma* of Abernethy, &c.

This texture has less consistence than the scirrhous, though it has more than the cerebral substance; it is of a milky white, variegated, when it is cut, by red points formed by the divided vessels; these are in fact very numerous in it; but their parietes are very thin, and hardly bear the effort necessary for injection. The masses which this texture forms are divided on their surface by lobes convoluted nearly like those of the brain; a very

soft cellular texture fills the interstices of these lobes. These masses occupy at first but a very limited extent, and are afterwards propagated in all directions ; this is what is seen, for example, in the eye, which is frequently the seat of this alteration, and in which it occupies most often in the beginning, a single point only of the retina, from which it extends to the whole of the eye.

In the period of softening, which comes on soon in this texture, and the progress of which is very rapid, it assumes the appearance of the softened cerebral substance, and forms a sort of rose-coloured jelly, on account of the blood which is mixed with it ; often even the rupture of the vessels which pass through it, occasions real hemorrhages, and effusions of blood having some analogy with those which the same cause produces in the brain ; there is sometimes formed, in consequence of these exudations, a membrane in the form of a cyst, as in apoplexies.

Besides, the resemblance is not perfect between the cancerous texture and that of the brain, and we ought not yet to admit the opinion of those who regard these textures as identical, and conclude from it that there is an effusion of nervous fluid in the production of the first.

IV. *Of Melanosis.*

This production, thus named by M. Laennec, is united to the preceding by J. F. Meckel. M. Broussais thinks that it is a tubercular texture, the black colour of which is owing to the advanced age of the individuals who are the subjects of it ; but it is not proved that old people are the most frequently affected with it. The same author makes a more accurate approximation perhaps, between this colour and that of the membranes in which the blood

has remained for a long time, as in consequence of some phlegmasias of long standing.

Melanosis should be distinguished from the black matter of the lungs. The latter, which is found in most subjects after the age of from twelve to fifteen years, which increases progressively with age, and which tinges the bronchial glands, the surface of the lungs and the interstices between the lobules, does not constitute a disease.

The black colour of this texture is perfect and entirely opake; its consistence is considerable; and it resists efforts made to tear it. It accumulates sometimes in masses of a certain size; at other times it forms striæ or plates, more or less extensive. Its interior appears to be homogeneous; no kind of structure is discoverable in it. This matter rarely becomes soft; when this does take place, there results from it a sort of black pap or a serous fluid, mixed with a grumous matter of the same colour.

Melanosis is much more compatible, than the other morbid textures, with a state of health; so different is its nature from that of these textures. M. Barruel, chief of the chemical department of the Faculty of Medicine, has recently examined for me some melanosis extracted from a mare, which had a great quantity of it in the muscles, in many viscera and especially under the skin of the perineum and the mammæ; it appears from his examination that melanosis must be considered as a mass of matter coloured with blood and fibrin, both in a peculiar state, and in which is found a little albumen, three distinct fatty substances, and much of the phosphate of lime and iron.

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